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PSYCHE

VOL. XXVII FEBUARY, 1920 No. 1

NOTES ON FOREST INSECTS.

III. TWO NEW SPECIES OF PITYOPHTHORUS FROM COLORADO.

By M. W. Blackman, Ph.D.,

Professor of Forest Entomology, New York State College of Forestry, Syracuse, N. Y.

Pityophthorus bassetti sp. nov.

Reddish brown 2¾ times as long as broad.

Male—length 2.2 mm. The *front* with distinct elevated transverse carina at level of upper inner angle of eye; above carina coarsely punctured, somewhat rugose and shining; below carina slightly excavated, more finely and densely punctured with moderately short and fine hairs; epistomal margin bordered with longer, coarser hairs; *eyes* rather elongate oval, not coarsely granular, with anterior emargination as broad as deep; *antennal* club short oval with segments sub-equal, first suture straight, second and third procurved ventrally; outer part of funicle one third longer than pedicel.

Pronotum very little longer than broad, sides of basal half nearly parallel but widest at the middle and very slightly arcuate; front broadly rounded and rather weakly serrate on the margin; anterior half armed with moderately coarse, acute asperities which are often arranged in fairly regular concentric lines, with their bases often continuous; summit fairly prominent with slight but distinct transverse depressed area immediately posterior to it which is divided by a smooth slightly elevated median area and bordered laterally by fainter elevated lines; depression more deeply and densely punctate; punctures becoming finer and sparser posteriorly and finer laterally; basal marginal line fine but distinct, slightly sinuate. Ventral surface of prothorax grooved and smooth behind but distinctly punctured with fine hairs in front.

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Elytra equal in width to the thorax; sides nearly parallel but slightly widest near middle, suddenly and strongly rounded behind origin of the declivity with tips sub-acuminate; strial punctures moderately large and deep, not entirely regular near suture; striæ not impressed; interstitial punctures very sparce and of moderate size; nearly glabrous above but with a few fine

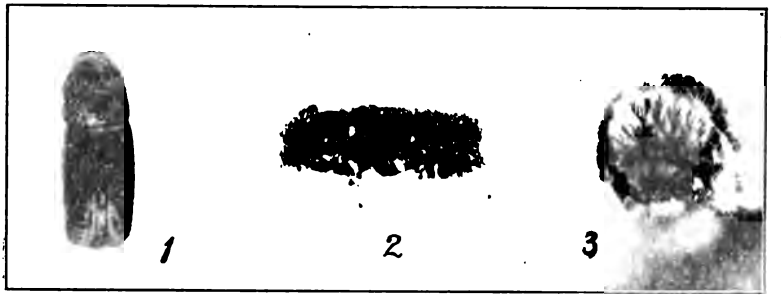

Fig. 1. 1, Dorsal view of male paratype of *Pityophthorus bassetti, sp.* nov., magnified 11 diametera; 2, lateral view of male, magnified 12 diametera; 3, front view of head of female, showing the circular pubes-cent area bordered by louger and coarser hairs, magnified 32 diameters.

short hairs, these becoming more abundant and longer at sides and behind. Declivity steep with deep wide sulcus; suture wide, elevated, with several coarse granules near apex; lateral elevations with fairly sharp serrate edge armed with 10 to 12 moderate sized, black teeth, each with a stiff tactile hair arising from its inner base. Last ventral abdominal segment deeply and very broadly emarginate.

Female, slightly longer (2.4 mm.) and of same width. Differs from male in having the frons very slightly concave, with a nearly circular area finely and densely punctured and pubescent and bordered with longer coarser incurved hairs. Elytra much less hairy at sides and rear than in male. Lateral elevations of the declivity with serrations of the male replaced by a sparse row of minute granules, long tactile hairs absent.

From Pitkin, Colorado. Bred from material brought in by Mr. R. O. Bassett, Jr.

Host tree: *Picea engelmanni* Engelm. Will also breed successfully in *Abies balsamea* (Linn.) Miller.

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The material from which *Pityophthorus bassetti* was bred consists of several slabs taken from the base of an Engelmann spruce near Pitkin, Colorado by Mr. R. O. Bassett, Jr., a former student. These were received at Syracuse Nov. 23, 1915 and upon examination the bark was found to contain numerous living nearly full grown larvæ of a scolytid. Further examination yielded the dead parent beetles and these proved to be an unknown species of Pityophthorus. The slabs were placed in a breeding jar in the laboratory and a considerable number of beetles emerged during the first two weeks of December. Part of these were preserved as specimens while the rest were left in the breeding jar and several pieces of a freshly cut limb of balsam fir about 1 inch in diameter were introduced. The adults readily entered not only the fresh balsam, but also some reentered the slabs of Engelmann spruce from which they had emerged—breeding in both. The new second generation of adults emerged from these two hosts during the summer of 1916 and many of them were still alive in September, at which time also a few small larvæ doubtless of a third generation were found. It would appear that normally there is not more than one generation per year.

The bark on the Engelmann spruce in which the beetles originally bred was about $\frac{3}{16}$ of an inch thick, while that of the balsam limbs to which the new brood readily transferred was only $\frac{1}{16}$ of an inch thick. In the former the larvæ worked nearly entirely in the inner and middle bark usually not even grooving the sapwood while in the latter the larval mines were excavated partly from the sapwood. Aside from this the engravings in the two are similar. In their general characteristics the engraving is not unlike those of other species of this genus. It consists of an entrance gallery leading diagonally upward and inward to the junction of bark and sapwood where it is expanded into an irregular nuptial chamber. From this a variable number of egg-galleries branch off from all sides, but these soon take a general longitudinal direction. In number the egg-galleries vary from 4 to 9 and the average in 13 engravings in balsam fir is 6.9. The effect of this large proportionate number of females to each male upon their relative fecundity could not be determined satisfactorily because of the injuries to the engravings by the numerous brood.

The egg-galleries which have a general longitudinal direction are

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not excessively long when compared with those of several other species of this genus. In the material at hand they vary from 3½ cm. to 7 cm. with an average length of 4.2 cm. The egg niches, where these are still recognizable, occur on both sides of the gallery and are not closely arranged—usually being 2 mm. or more apart so that the number of eggs laid by each female is probably not great.

Pityophthorus occidentalis sp. nov.

Reddish brown to nearly black in color; 2.8 times as long as broad.

Male. Length 2.5 mm. *Front* convex with distinct rough transverse carina below level of upper inner angle of eyes, coarsely and roughly punctured above, slightly excavated and more finely punctured below carina, with distinct median vertical carina from transverse carina to margin of epistoma; fine short hairs over entire front but becoming more conspicuous cephalad; edge of epistoma emarginate and bisinuate, bordered with coarser and longer hairs; eyes oval with rather wide and deep emargination; antennæ light reddish-brown, club oval, with first three segments sub-equal and fourth segment shorter; first and second sutures on ventral face nearly straight, third strongly arcuate; outer part of funicle one-half longer than pedicel.

Pronotum slightly longer than broad (14:13), widest behind the summit; sides of basal half slightly arcuate, faintly constricted in front of middle, broadly rounded in front, with distinct nearly regular serrations, slightly more than the cephalic half armed with well developed asperities arranged in concentric nearly regular rows; summit prominent; posterior area shining, with rather numerous moderate sized punctures, except on the impunctate slightly elevated area in the median line; basal marginal line distinct and continued diagonally downward along the sides as a margined ridge easily distinguishable to a point anterior and dorsal to the base of the prothoracic leg. Ventral surface of the prothorax punctured in front, smooth behind except immediately adjacent to the base of the leg.

Elytra of same width as prothorax; sides subparallel, widest before the middle, slightly narrowed behind the middle to the level of the origin of the declivity, from which point it is strongly and

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BLACKMAN—Forest Insects.

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regularly rounded; tips not acuminate; strial punctures moderately fine, in regular rows except near base where they are somewhat confused, first stria impressed, the others not; interstrial punctures fine and very sparse, almost lacking on the disc; disc nearly glabrous but with a few small hairs, these becoming longer and more numerous at the sides and behind; *declivity* steep with deep, rather narrow sulcus; suture granulate and widened toward apex; lateral elevations abrupt and granulate; granules of the 3rd and 4th interspaces forming two rows which converge and become confused near apex, those of 4th interspace smaller but distinct, others more or less confused, each of granules with a rather long stiff tactile hair arising from near its base. Ventral abdominal segments rather finely punctured and moderately hairy; last segment deeply and broadly emarginate.

Female, of the same general proportions. *Front* flattened, with nearly circular pubescent area bordered by coarser and longer incurved hairs; prothorax as in male; apex of elytra more acutely rounded but not acuminate; declivity not so steep, sulcus not so deep, lateral elevations not so pronounced, with a sparse row of minute granules on the 3rd interspace and a few scattered ones lateral to it; long tactile hairs absent.

Host tree: *Picea engelmanni* Englm.

Locality: From Pitkin, Colo., collected by Mr. R. O. Bassett, Jr., October, 1915.

Explanation of Plate I.

Fig. 4, 5. Slabs from the trunk of Engelmann spruce showing the engravings of *P. bassetti* in the inner bark and the exit holes through the outer bark. About two-thirds natural size.

Fig. 6. Two segments from the limb of a balsam fir, showing the engravings of *P. bassetti* on the surface of the sapwood. About three-fifths natural size.

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HYMENOPTERA COLLECTED NEAR BOSTON, MASS., WITH DESCRIPTION OF A VARIETY OF *BOMBUS AFFINIS*.

By J. Bequaert,
American Museum of Natural History, New York City.

While collecting Hymenoptera at Forest Hills, Mass., and other localities in the vicinity of Boston, I have taken on two occasions a bumble-bee, which from its aberrant coloration could not be properly named with Franklin's "Bombidæ of the New World." I have been permitted to examine similarly colored *Bombus*, taken some years previous by Professor Wheeler at Forest Hills and by Mr. J. E. Smith at Sherborn, Mass. It was finally recognized that all these specimens belong to a striking color-variant of *Bombus affinis*, which it is the purpose of this note to describe and name. I have used this opportunity to present an account of the Bombidæ of the neighborhood of Boston and to record some other interesting Hymenoptera of that region.

I am greatly indebted to Prof. Wm. M. Wheeler, Messrs. N. Banks, Wm. T. Davis, C. W. Johnson, E. J. Smith, C. Schaeffer, and Dr. F. E. Lutz, who have kindly allowed me to examine material in their possession or care and to use valuable information.

Bombus affinis var. **novæ-angliæ** var. nov.

Known in the worker and male phases, which are colored much the same. One or more of the abdominal segments behind the second are covered entirely or to a large extent with ferruginous pile (in the brightest specimens very near Ridgway's vinaceous-rufous). Coloration otherwise as in typical *affinis;* in most of the specimens the usual reddish tinge of the yellow pile on the middle portion of the second tergite is rather faint or faded, which, moreover, is often the case with typical *affinis* too.

The structural characters show no differences with those of typical *affinis;* this is especially true for the shape of the male genitalia, which I have carefully compared with those of the typical form.

The specimens examined do not differ in size from typical *affinis;* total length of the worker: 12 to 14 mm.; of the male: 16 to 17 mm.

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Type locality: Forest Hills, Mass.; the holotype, a male taken by Prof. Wm. M. Wheeler, is deposited at the Museum of Comparative Zoölogy, Cambridge. The allotype, a worker from the same locality, is in the American Museum of Natural History. Also known from Sherborn, Mass., and Brooklyn, N. Y.

The extent of ferruginous pile on segments 3 to 6 is variable, the following being the combinations observed:

1. Ferruginous pile covering the major part of the fourth tergite; the extreme sides of this tergite and the whole of segments 3, 5, 6, and 7 being black: one worker from Forest Hills, August 3, 1911 (Wm. M. Wheeler Coll.; allotype); two males from Sherborn, August 30 and September 8, 1913 (E. J. Smith Coll.).

2. Ferruginous pile covering the whole of tergite 4 and extending over the apical margin of tergite 3: two males from Forest Hills, June, 1911 (holotype of var. **novæ-angliæ**) and August 18, 1911 (Wm. M. Wheeler Coll.).

3. Ferruginous pile covering the entire fourth tergite; also the greater part of tergite 5, though with some admixture of black hair; tergite 6 with a few rufous hairs in the black pile at the base in the center: one male taken at Forest Hills, visiting the flowers of *Lythrum Salicaria*, August 12, 1919.

4. Tergites 4, 5, and 6 covered with ferruginous pile, except at the extreme sides and in the middle along the apical margin, where the pile is black: one male from Brooklyn, N. Y., July, 1915 (F. M. Schott Coll.).

5. Ferruginous pile very bright, covering the entire fourth tergite, tergite 3 except for a median patch of black hair near the base, and the basal part of tergite 5: one worker taken in the Arnold Arboretum at Forest Hills, collecting pollen of a cultivated variety of *Viburnum*, August 3, 1919. This very brightly colored specimen mimics to a certain degree *Bombus ternarius* Say.

It is not without some hesitation that I propose a varietal name for this curious color-variant of *Bombus affinis*. It has been the great merit of Franklin to elucidate the structural characters of the North American Bombidæ; and, while carefully recording the color-variants of each species, this author has wisely refrained from applying names to them. Indeed, it will be a lengthy process for future students to decide which of the many color forms of bumblebees are mere freak specimens, and which others represents racial

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differences due either to somatic and environmental influences or to germinal modifying factors. There is, I believe, ample justification for giving such fixed races a nomenclatural standing, as has been the common practice for recent years. Moreover, European students have profusely named the color forms of the palearctic bumble-bees, and, with increasing interest in the study of distributional problems, a similar course will undoubtedly be adopted for the nearctic species.

In the case of *B. affinis* var. *novæ-angliæ* there is every reason to believe that it is not based on freak specimens, but represents a peculiar race, which, having been repeatedly collected, must not be a great rarity in the vicinity of Boston and perhaps in some other localities. Furthermore, *Bombus affinis* varies, as a rule, but little in its coloration, since Franklin, in his Monograph, does not mention a single color-variant and even notes that "this species is very constant in its character, a remarkable fact when the extreme variability of a large proportion of the species of the *Terrestris* group is considered."[1] I have examined over 150 specimens of *B. affinis* from various localities in the states of New York, New Jersey, Pennsylvania, New Hampshire, Massachusetts and North Carolina, and, with the exception of the specimens described above, have only found one aberrant male. This male, collected at Woodbury, N. Y., September 21, 1910, and belonging to the American Museum of Natural History, shows a faint indication of a transverse patch of ferruginous pile in the center and near the base of the fourth tergite; the specimen is otherwise quite normal, but is evidently a transition toward the var. *novæ-angliæ*.

Since this paper was sent to the printer, I have been able to examine several specimens of *B. centralis* Cresson and its var. *juxtus* Cresson, from Colorado, in the collection of the American Museum of Natural History. Such of these specimens as agree best with the description of *juxtus* Cresson, are very similar in coloration to the brightest individuals of *B. affinis* var. *novæ-angliæ*. *B. centralis* and *B. juxtus* are, however, at once separated from *B. affinis* by their much longer oculo-malar space and by their having yellow pile on face and occiput. Titus[2] has recorded *B. juxtus* from Woods Hole, Mass.; but, as Franklin has pointed out,

[1] Trans. Amer. Ent. Soc., 38, 1913, p. 280.
[2] Canadian Entomol., vol. 34, pp. 39 and 43 (1902).

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this identification was undoubtedly erroneous. It seems very probable that these Woods Hole specimens belonged to *B. affinis* var. *novæ-angliæ*.

In drawing up the following list of the Bombidæ known to occur within a radius of twenty miles from Boston, I have perused, besides my own data, collected during the summer of 1919, information kindly given to me by Prof. Wm. M. Wheeler and Messrs. N. Banks, C. W. Johnson and E. J. Smith.

Bombus terricola Kirby. This is perhaps the most common species of bumble-bee at Forest Hills; also at Auburndale (C. W. Johnson Coll.) and Sherborn (E. J. Smith Coll.).

Bombus affinis Cresson. The typical form is common at Forest Hills where it visits, among others, the flowers of *Ceanothus americanus;* also at Auburndale and Dedham (C. W. Johnson Coll.); Sherborn (E. J. Smith Coll.).

Bombus bimaculatus Cresson. Common at Forest Hills; also at Cohasset (C. W. Johnson Coll.) and Sherborn (E. J. Smith Coll.).

Bombus impatiens Cresson. Forest Hills; also Auburndale, Dedham, Brookline, and Cohasset (C. W. Johnson Coll.); Sherborn (E. J. Smith Coll.).

Bombus ternarius Say. Mr. E. J. Smith, who has taken a few workers of this species at Sherborn, believes that it is very rare near Boston. Professor Wheeler informs me that in many years collecting he has never seen it at Forest Hills, though he has commonly taken it at Colebrook, Conn.

Bombus perplexus Cresson. Wollaston (Mus. Comp. Zoöl.); Auburndale and Arlington (C. W. Johnson Coll.); Sherborn (E. J. Smith Coll.).

Bombus vagans Smith. Forest Hills; also from Auburndale, Dedham, and Boston (C. W. Johnson Coll.); Sherborn (E. J. Smith Coll.).

Bombus fervidus Fabricius. This is a common species at Forest Hills; also at Auburndale and Cohasset (C. W. Johnson Coll.); Sherborn (E. J. Smith Coll.).

Bombus americanorum (Fabricius) = *Bombus pennsylvanicus* Franklin. Rather scarce near Boston; I have taken it at Lexington and Mr. E. J. Smith has it from Sherborn.

Bombus separatus Cresson. Sherborn (E. J. Smith Coll.).

Mr. E. J. Smith informs me that he has also seen a female of *B.*

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auricomus (Robertson), which, according to its label, was taken near Boston many years ago. Neither he nor Professor Wheeler has ever taken that species there, and no Boston specimens are contained in the collections of the Boston Natural History Society and of the Museum of Comparative Zoölogy.

Psithyrus laboriosus (Fabricius). Five males were taken at Forest Hills, about the middle of August, and one female in the Stony Brook Reservation at flowers of *Cephalanthus occidentalis*, July 21; also at Auburndale and Brookline (C. W. Johnson Coll.); Sherborn (E. J. Smith Coll.).

Psithyrus ashtoni (Cresson). Auburndale and Brookline (C. W. Johnson Coll.); Cambridge (S. Henshaw Coll.); Sherborn (E. J. Smith Coll.).

It is interesting to compare this list with other local faunas farther north and south. At Waldoboro, on the coast of southern Maine, Lovell[1] did not find *Bombus impatiens*, *B. americanorum* and *B. affinis*, three species which are rather abundant in the Transition Zone. On the other hand, two forms which are rather Canadian or Boreal, *B. borealis* Kirby and *B. ternarius* Say, are still to be found in southern Maine, while *borealis* has never been seen near Boston and *ternarius* is very rare there. Otherwise the faunas of these two localities are very similar.

From my own collecting experience and from what I have seen in other collections, the bumble-bee fauna of the immediate vicinity of New York City differs mainly from that of Boston in the scarcity of *B. terricola* and the absence of *B. ternarius*, though both these species are commonly found in the Catskills. *B. ternarius* has never been taken near New York City; the nearest locality for that species is Lake Marcia, Sussex County, N. J., where it was collected by Dr. F. E. Lutz.[2] As to *B. terricola*, there are no New York specimens in my own collection, nor in that of Mr. Wm. T. Davis; I find, however, in the Brooklyn Institute of Arts and Sciences two males from Essex Fells, Essex County, N. J. (A. S. Nicolay Coll.) and, in the American Museum of Natural History, two further specimens labeled "Astoria, Long Island." Two species of the Austral Zone, *B. fraternus* (Smith) and *B. auricomus*

[1] J. H. Lovell. The Bumble-bees of Southern Maine. Ent. News, 18, 1907, pp. 195–200.

[2] Bull. Amer. Mus. Nat. Hist., 35, 1916, p. 514. The specimen recorded as *B. ternarius* from Staten Island in Smith's New Jersey List, is a worker of *B. fervidus*, though it bears a label in the late Dr. Ashmead's handwriting "*B. ternarius* Say."

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(Robertson), though often seen in southern New Jersey, apparently do not reach New York City.

The vicinity of Boston thus seems to be in some way the meeting ground of certain Boreal and Austral elements, while forms of the Transition Zone constitute the bulk of the local fauna. This may be one of the reasons why the insect fauna of that region contains such a variety of species. Though I was able to devote to collecting only a few odd hours during two of the last summer months, I have to my great surprise taken there many unusual Hymenoptera, among them certain species which I had not seen before in the northeastern states. It will, I believe, be interesting to put on record some of my captures.

Pachymenes symmorphus (Saussure). Two females were taken in the Arnold Arboretum at Forest Hills, July 5. This wasp has been placed by H. de Saussure in the genus *Nortonia*. I have shown elsewhere[1] that *Nortonia* may best be restricted to the species with a transverse raised suture on the first abdominal tergite; whereas such species as the nearctic *N. symmorpha* Saussure and *N. tolteca* Saussure, in which there is no raised suture on tergite one, cannot in my opinion be generically separated from *Pachymenes*. I have also *P. symmorphus* from Greenwood Lake, N. Y., ♀, August 20, 1916; White Plains, N. Y., ♂, at flowers of *Ceanothus americanus*, June 29, 1918; Stowe, Lamoille County, Vt. (E. L. Bell Coll.). Mr. Wm. T. Davis has taken a ♀ at Ramsey, N. J., July 19, 1908, and a ♂ at Cabin John Run, Md., June 17, 1910.

Ancistrocerus unifasciatus (Saussure). One female at Lexington, July 27, 1919, and another at Forest Hills in June.

Anacrabro ocellatus Packard. This was very common at Forest Hills in the latter half of July, visiting *Ceanothus americanus;* I have also taken it at Lexington on *Spiræa salicifolia*, July 27.

Euspongus bipunctatus (Say) = *Paramellinus bipunctatus* Rohwer. Forest Hills, August 3, 1919; one female running about on leaves of pickerel weed in the Arnold Arboretum.

Anthophora walshii Cresson. One female sucking honey at flowers of *Ballota nigra*, Forest Hills, July 27, 1919. I saw a male, which I was unable to capture, at the flowers of *Pontederia cordata*, Forest Hills. Mr. C. W. Johnson informs me that the collection

[1] Bull. Amer. Mus. Nat. Hist., 39, 1918, p. 93.

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of the Boston Society of Natural History contains further specimens of this species as follows: Woods Hole, Mass., ♀, July 25, 1903 (C. W. Johnson Coll.); Manomet, Mass., ♂, July 17, 1904, and Falmouth, Mass., ♂, July 8, 1912 (Dr. J. A. Cushman Coll.). In these two males, the terminal joint of the middle tarsi bears the lateral patches of black pubescence characteristic of this species; furthermore, there are at the base of the clypeus two black spots narrowly connected in the middle. These points, together with the white tegumentary bands of the abdomen, make the species easy to recognize. So far as I have been able to discover, this beautiful insect, originally described from Illinois, has also been recorded from Wisconsin, Nebraska and central Texas. At Carlinville, Ill., Robertson found it sucking nectar on several flowers, among them *Lespedeza reticulata*, while the females gathered pollen exclusively from *Cassia Chamæcrista*.[1] In Nebraska, it was taken at the flowers of a *Salvia*, and Graenicher records it from *Rudbeckia hirta* in Wisconsin.

Xenoglossa pruinosa (Say). This handsome species is a common visitor of the flowers of cultivated squash at Forest Hills, between 6 and 8 a. m.; the flowers close by 9 a. m., but the males can often be found during the day, sleeping inside the corolla.

Dianthidium notatum (Latreille). This is fairly common in the first half of August at Forest Hills, on flowers of *Lespedeza hirta* and *L. frutescens*, which are visited by both sexes. I have also taken it at the Blue Hills Reservation, on *Baptisia tinctoria*.

Halictoides novæ-angliæ Robertson. Many males were seen at the flowers of *Pontederia cordata* in the Arnold Arboretum, Forest Hills, from July 8 to August 15; the females are much scarcer and appear later, the first being taken July 24.

Perdita octomaculata (Say). At Forest Hills this little bee was seen nesting in the sandy soil of a vacant city lot; on August 10, the two sexes were found in numbers mating within the flowerheads of *Cichorium Intybus;* the female also visits *Solidago rugosa*.

Epeoloides pilosulus (Cresson). One male at the Blue Hills Reservation, on flowers of *Apocynum androsæmifolium*. *Epeoloides nearcticus* Ducke,[2] described from Pennsylvania, is in my opinion a synonym of *pilosulus*.

[1] Botanical Gazette, 25, 1898, p. 230; and 28, 1899, p. 36.
[2] Rev. d'Ent. Caen, 27, 1909, p. 39.

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THE FIRST STAGE LARVA OF *CUTEREBRA AMERICANA* (FABR.) (DIPTERA; OESTRIDÆ).

By G. F. Ferris,
Stanford University, California.

There appears to be but little information concerning the first stage larvæ of any species of Oestridæ, the only very detailed figures that I have seen being those given by Hadwen and Cameron[1] of the larvæ of three species of Gastrophilus. I have been fortunate enough to secure some notes on the first stage of *Cuterebra americana* (Fabr.) (det. Aldrich) and present them in order that they may not be lost, brief though they are.

A female of this species was taken in flight at Palo Alto, Calif., on October 8 and was confined in a glass jar. On this same day (perhaps partially on the following) this female deposited from 100 to 150 eggs which were placed singly and were attached to the glass by a glue so powerful that the eggs could not be detached without being destroyed. Unfortunately no notes were kept as to the shape of the eggs.

The eggs began to hatch on October 22. In the case of the species discussed by Hadwen and Cameron there has existed some doubt as to whether the eggs hatch normally without the stimulus of moisture, heat and friction, although these authors found that at least a certain percentage do. In the case of *Cuterebra americana* these factors seem to have no place as apparently all the eggs hatched.

The first stage larvæ are extremely active. Clinging to the empty egg shells they waved the head energetically about in the air and some of them deserted the egg shells and moved about, progression being accomplished by means of a looping movement much like that of a Geometrid caterpillar. No notes were kept as to the length of time that the larvæ lived without food.

Description of the Larva.

Length (flattened on slide) 1.4 mm.; body fusiform, tapering at both ends (Fig. A). Posterior extremity ending in a single flat lobe

[1] Hadwen, S. and Cameron, A. E. A Contribution to the Knowledge of the Bot-Flies, *Gastrophilus intestinalis* DeG., *G. hæmorrhoidalis* L. and *G. nasalis* L. Bull. Ent. Res., vol. 9, pt. 2, pp. 91–106, figs. (1918).

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which projects well beyond the spiracles and is slightly emarginate at the tip. The actual number of segments cannot be determined from the mounts, but there are in all nine transverse series of posteriorly pointing denticles. The anteriormost series is close to the anterior end of the body and is composed of very small denticles. The second to fourth series are each composed of a single row of flat denticles, the points of which are directed toward the median line and end in a recurved hook (Fig. B). Between each two of these

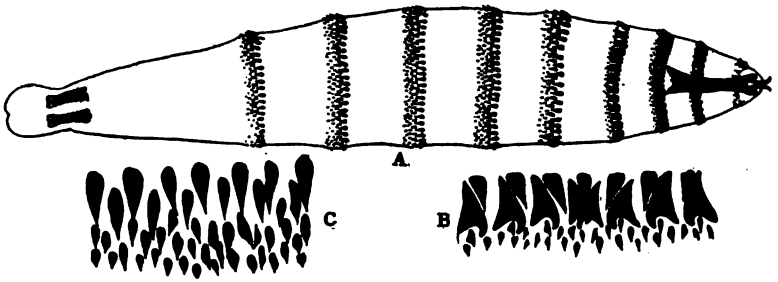

Fig. 1. *Cuterebra americana*, first stage: A, entire larva only the bases of the tracheal trunks are indicated; B, denticles from third series at the median line; C, denticles from fifth series.

denticles are smaller sharply pointed denticles and behind them are a varying number of still smaller, sharp denticles. The remaining series are all composed of numerous sharply pointed denticles, of which the anteriormost are much larger than the others (Fig. C). The cephalopharyngeal apparatus extends back to the anterior margin of the third series.

Note.—The above description is based upon specimens that have been cleared, stained and mounted on a slide.

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A REVISION OF THE SPECIES OF THE GENUS LOXOCERA, WITH A DESCRIPTION OF A NEW ALLIED GENUS AND A NEW SPECIES.

By Charles W. Johnson,
Boston Society of Natural History.

Species based entirely on color, a character which further study proves to be very inconstant, are a source of considerable trouble to the student. After a great deal of collecting, and a study of some 75 specimens including Loew's types, it seems apparent that Say's *Loxocera cylindrica* represents an extremely variable species, which for convenience and to more fully emphasize this variability might be divided into four varieties according to the following table.

Table of Species.

1. Wings hyaline with the tips and posterior cross veins distinctly clouded.....*cylindrica* Say
   - *a.* Anterior margin of the thorax, a dorsal line, humeri, and lateral lines, black.....var. *cylindrica* Say
   - *b.* Anterior margin very broad, covering at least one-third of the thorax, a dorsal line, short lateral lines and about one-third of the anterior of the pleura, black var. *pleuritica* Loew
   - *c.* Dorsal line, humeri, lateral margins and the upper half of the pleura, black.....var. *pectoralis* Loew
   - *d.* Dorsal and lateral lines (sometimes obsolete) and a spot above the yellow humeri, black.....var. *obsoleta* var. nov.

   Wings brownish, without the apical clouding.....2
2. Anterior third of the thorax black, dorsal and lateral lines wanting; abdomen, except the sides of the first segment, black *collaris* Loew

   Anterior and lateral margins and a dorsal line on the thorax, black; abdomen except at the base red....*fumipennis* Coq.

Loxocera cylindrica Say.

L. cylindrica Say, Jour. Acad. Nat. Sci., Phila., III 98, 1823.

Say's description is very clear: "Thorax with an undulated

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band on the anterior margin, dorsal line and an obsolete line before the wing, black; wings a little dusky, particularly at tip." This represents practically the more characteristic or intermediate form merging into the darker *pleuritica* on the one hand and the lighter colored *obsoleta* on the other. Say's "var. a" I am calling *obsoleta*. It is the prevailing form of southern Pennsylvania and New Jersey and is the only form found by the writer in southern Virginia and North Carolina. The variety *pleuritica* is the prevailing form from New Jersey northward; it is often confused with *pectoralis*, a much rarer form, of which I have typical examples from only three localities, and in each case a female, as is the type. In its dorsal thoracic markings it approaches *obsoleta*, as the anterior marginal band is interrupted in both cases.

The following records show the northern and southern distribution of the species and its varieties:

L. cylindrica Say (typical).

Glen House and Alstead, N. H.; Dummerston, Vt.; Auburndale, Fall River and North Adams, Mass.; Philadelphia, Pa.; Algonquin, Ill. (Dr. Nason); Minnesota (Washburn); Kansas (Snow). Type, Pennsylvania. I have not seen the specimens from Minnesota and Kansas.

var. **pleuritica** Loew.

Machias, Me.; Mt. Washington, N. H.; Norwich, Vt.; Montreal, Can.; Ithaca, N. Y.; Agricultural College, Mich.; Auburndale and Woods Hole, Mass.; Delaware Water Gap, N. J.; Kansas (Snow). Types, Connecticut, New York.

var. **pectoralis** Loew.

White Mountains, N. H.; Mt. Ascutney, Vt.; Auburndale, Mass.; Edge Hill, Pa. Type, Washington, D. C. Two specimens (♂ ♀) from Great Falls and Chain Bridge, Va. (N. Banks) have the black of the pleura interrupted below the wings.

var. **obsoleta** var. nov.

Burlington, Vt.; Plymouth, Mass.; Branford, Conn.; Delaware Water Gap, and Clementon, N. J.; Philadelphia and Natrona, Pa.; Potomac Creek and Suffolk, Va., and Hertford County, N. C.

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Loxocera collaris Loew.

This is usually smaller than *L. fumipennis* Coq., and readily distinguished by characters given in the above table. Specimens from Washington and Oregon I cannot separate from those of the eastern states, thus giving it a wider distribution than any of the other species. Aside from the typical locality, District of Columbia, there are specimens in the collection of the Boston Society of Natural History from Liberty, Me. (J. A. Cushman); Medford, Mass. (G. W. Barber); Salem, Mass. (A. P. Morse). Also from Great Falls, Va., May 19 (N. Banks), in the Museum of Comparative Zoölogy.

Loxocera fumipennis Coq.

Except for the uniform dark brown wings, the species resembles *L. cylindrica.* It is more clearly related to the European *L. elongata* than any of the other American species. Distribution, Kansas, Texas and Colorado.

Loxocera quadrilinea Walker.

The identification of this species from the description is hopeless.

Pseudopsila new genus.

This represents a group intermediate between the true Loxocera and Psila. The former has the third joint of the antenna at least five times as long as the second and exceeding the length of the arista. The typical species of the genus Psila (*P. fimentaria* L.) has an ovate rounded third antennal joint scarcely longer than the second. In Pseudopsila the third joint is subcylindrical and about three times as long as the second, the latter being relatively shorter than in the typical Loxocera. Arista almost double the length of the third joint. One pre-dorso-central, immediately in front of the suture (these are easily broken and are present on but few of the museum specimens), one post-dorso central just in front of the scutellum, two supra alar and a small presutural bristle. Type, *Loxocera fallax* Loew.

Table of Species.

1. Thorax entirely black.....*fallax* Loew
   Thorax yellow marked with black.....2

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2. Dorsum without lateral margins of black.....3
   Dorsum with lateral margins of black.....4
3. Humeri and upper half of the pleura black....*angustata* Cress.
   Anterior margin, pleura, metanotum and a narrow dorsal line black.....*perpolita* sp. nov.
4. With broad lateral margins only, upper half of the pleura black.....*biviatta* Loew
   With a broad anterior and lateral margins, upper half of the pleura black.....*collaris* Loew

Pseudopsila fallax (Loew).

Loxocera fallax Loew, Cent., IC, 89, 1869.

In a note Loew refers to this species as being intermediate between Loxocera and Psila. It is readily distinguished by having both the thorax and abdomen shiny black. It has the following distribution: Mt. Washington, 4,000 feet, Glen House and Intervale, N. H.; Auburndale, Cohasset and Fall River, Mass.; Kaaterskill and Axton, N. Y. Type locality, Canada.

Pseudopsila perpolita sp. nov.

Head yellow, upper half of the occiput and vertical triangle black; third joint of the antennæ black about three times as long as the second; aristæ white. Thorax including the scutellum yellow, with short yellow hairs, anterior margin, a stripe occupying the greater portion of the pleura and the metanotum, shiny black. A very narrow blackish dorsal line is also present, which is usually obsolete behind the suture. One pre-dorso-central just in front of the suture, and one post-dorso-central in front of the scutellum, the alar bristles are wanting. Abdomen shiny black, with short yellow hairs, ovipositor yellow. Halteres white. Wings hyaline, veins light yellow, wings noticeably large for the size of the fly, anterior cross vein slightly nearer the base of the discal cell than in *P. fallax*, *i. e.*, less than one-third the length of the cell. Legs light yellow, tips of the tarsi brown. Length 4 mm.

Seven specimens, six females, Center Harbor, N. H., September 10, 1914 (C. W. Johnson), and one male, Liberty, Me., September 9, 1915 (Dr. J. A. Cushman). Holotype and three paratypes in the collection of the Boston Society of Natural History, two paratypes

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in the Museum of Comparative Zoölogy and one in the author's collection.

This species resembles *Psila lateralis* Loew in general appearance, but the longer antennæ readily separate it from that species, while from *P. collaris* Loew, it is at once distinguished by the highly polished black markings and the absence of black on the sides of the dorsum.

Pseudopsila angustata (Cresson).

Psila angustata Cresson, Proc. Acad. Nat. Sci., Phila., 1919, p. 193.

An interesting species resembling in color *Psila lateralis* Loew, but much larger. The pre-dorsal-centrals are not present in the two specimens before me, neither are they present in the two following species. In addition to the type locality, Ithaca, N. Y., it has been taken by Mr. A. P. Morse at Woodstock, Vt.

Pseudopsila bivitatta (Loew).

Psila bivittata Loew, Cent., VIII, 67, 1869.

The form of the antennæ places this also in this group. It is common and quite widely distributed from Quebec (Osten Sacken) and Maine to Philadelphia, Pa., and probably much farther South. Type from Connecticut.

Pseudopsila collaris (Loew).

Psila collaris Loew, Cent., VIII, 68, 1869.

This may prove to be only a variety of the preceding. Distribution, White Mountains, N. H. to Virginia. Type also from Connecticut.

PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB.

The annual meeting of the Cambridge Entomological Club was held January 13 at the Bussey Institution, Forest Hills, Boston, and the following officers were elected for 1920:

President, C. A. Frost, Framingham.
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Executive Committee, S. W. Denton, Wellesley; L. W. Swett, Lexington; P. G. Bolster, Boston.

Editor of Psyche, C. T. Brues, Boston.

Mr. S. W. Denton presided and thirty-two members and guests were present.

Prof. Robert Matheson, of Cornell University College of Agriculture, spoke on the three species of plant lice of apple trees, *Aphis pomi*, *Aphis sorbi* and *Aphis avenæ*, their habits, and methods of controlling them.

Mr. S. W. Denton gave an interesting account of his experiences in buying and selling butterflies in America and England.

Mr. A. F. Burgess, secretary of the Association of Economic Entomologists, spoke of the meetings of that society and of the Entomological Society of America at St. Louis.

ENTOMOLOGICAL NOTES FROM THE MUSEUM OF COMPARATIVE ZOOLOGY.

Several families of Neuroptera have recently been rearranged in new drawers. The largest of these, the Myrmeleonidæ, occupies 54 drawers and includes 2,395 specimens representing 309 named species, among which are 125 types.

Several lots of small neuropteroid insects have been obtained from Mr. Parish, collected on his Amazon trip.

In mounting a collection of insects from Anticosti Island a specimen of Ornithomyia was found to which were attached two specimens of Mallophaga, one on each side near the tip of the abdomen of the fly. This is doubtless one method of distribution of the parasites.

Mr. Dawson of the University of Nebraska spent the Christmas holidays at the museum studying Serica; Mr. Strickland of the Canadian Entomological Branch at Ottawa spent several weeks studying the collections of Acarina and Psocidæ, and Mr. Leonard of the Cornell University Agricultural College was at the museum in January to study the types of Leptidæ.

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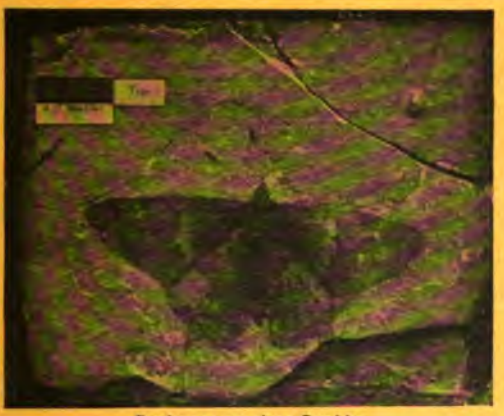

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A COMPARISON OF THE EXTERNAL ANATOMY OF THE LOWER LEPIDOPTERA AND TRICHOPTERA FROM THE STANDPOINT OF PHYLOGENY.

By G. C. Crampton, Ph.D.,
Massachusetts Agricultural College, Amherst, Mass.

Dr. August Busck and Dr. Bethune-Baker have very generously furnished the material upon which the following observations on the Lepidoptera were based, and Mr. Nathan Banks has kindly identified the adult Trichopteron described in the following discussion. To these gentlemen I would express my very sincere gratitude and appreciation for their generous assistance which has made this study possible.

One hundred years ago, that keen observer Leach, 1817 (Zoöl. Misc., Vol. 3) linked together the orders Trichoptera and Lepidoptera in a group to which Haeckel, 1896, applied the term "Sorbentia"; and most entomologists since Leach's time have agreed in regarding the orders Lepidoptera and Trichoptera as extremely closely related. Speyer, 1839 (Oken's Isis, 1839, p. 94) was, so far as I am aware, the first to suggest that the lepidopterous "family Micropterygidæ" forms a transitional group leading to the Trichoptera, and later in 1870 (Stett. Ent. Zeit., 1870, p. 202), he carried the comparison between the two groups still further. Subsequent investigations have served to confirm Speyer's views, and since the micropterygoids occupy such an important position from the standpoint of the phylogeny of the Lepidoptera, their affinities have been much discussed.

Chapman, 1894 (Trans. Ent. Soc. London, p. 335) divides the micropterygoids into two families, the Micropterygidæ and Eriocephalidæ. Meyrick, 1912 (Genera Insectorum, Fasc. 132) treats them as a single family, the Micropterygidæ, and divides them into three subfamilies, the Mnesarchæinæ, Eriocranianæ and Micropteryginæ. In the following discussion, these insects (which belong

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to three distinct families) will be treated as comprising a single superfamily, the Micropterygoidea, which constitutes the lepidopterous suborder Prolepidoptera.

Packard, 1895 (Monogr. Bombycine Moths, Part 1, Notodontidæ) makes *Eriocephala calthella* the "type" of a distinct suborder of Lepidoptera which he calls Lepidoptera laciniata, or Protolepidoptera, while he places *Micropteryx* in another suborder which he calls the Paleolepidoptera. Chapman, 1916 (Trans. Ent. Soc. London, 1916–1917, p. 310) raises *Micropteryx* to ordinal rank, proposing for it the name Zeugloptera, thus differing from practically all of his predecessors, who agree in regarding the micropterygoids as lepidopterous.

On page 307 of Part II of his treatise on Insects (Cambridge Nat. Hist.), Sharp, 1909, in discussing the fact that Brauer's distinction between the Lepidoptera and Trichoptera on the basis of the presence of mandibles in the pupæ of Trichoptera no longer holds good, makes the statement that "unless it should be decided to transfer *Micropteryx* to Trichoptera, and then define Lepidoptera and Trichoptera as distinguished by the condition of the pupa, it would appear to be very difficult to retain the two groups as distinct." On page xvii of the Proceedings of the Ent. Soc. of London, Sharp, 1896 had likewise suggested that the micropterygoids "should be treated as a group of Trichoptera whose larvæ are not aquatic in habits." Comstock, 1918, in his book on the "Wings of Insects," has followed these suggestions, treating the Micropterygina as a suborder of the Trichoptera, and referring to them as terrestrial Trichoptera. In reviewing Comstock's book, Tillyard, 1919 (Ent. News for May, 1919, p. 149) criticizes him for removing the micropterygoids from the Lepidoptera to the Trichoptera from the study of the wing-veins alone, and states that "even from the point of view of the wing-venation it is scarcely defensible, for a careful study of the freshly turned pupæ of any of the older families of Lepidoptera will show that their wing-tracheation agrees closely with that of *Micropteryx*, particularly in the different courses of Cu and I A in fore and hind wings. Moreover the pupal wing of *Micropteryx* has a complete tracheation; the imaginal wings have broad well developed scales of a higher type than any found in the Trichoptera; the fore wing does not possess a separate M^4; and the hind wing has a definite frenulum.

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In all these points this family is definitely Lepidopterous. Neither the larval form nor the imaginal mouthparts are Trichopterous, so that there is really no justification for so radical a change, which must remain as a serious blemish in a fine work."

In order to test the validity of Tillyard's criticism, it has seemed preferable to examine structures other than the wing veins in comparing the micropterygoids with the Tricoptera, and for this purpose, I have chosen the primitive little Trichopteron *Philopotamus distinctus*. These small caddice-flies are particularly interesting because the females have only rudimentary wings—a condition which, so far as I am aware, has been recorded but once before among North American Trichoptera. The bodies of both males and females are of a dusky black color, and the wings of the males are of a slightly ashen hue. Both sexes are found on stones along the banks of swiftly running streams, particularly in the neighborhood of waterfalls, and those found about Amherst first appear the latter part of April. The females have rather long hind legs enabling them to flee rapidly over the surface of the water with quick leaping movements, when disturbed, while the males under these conditions dart to the surface of the water, and after making a short series of "leaping" flights, come to rest on the bank a short distance from the place whence they were dislodged. At the beginning of the season, neither males nor females are readily disturbed, and may be easily captured by a quick grasp with a pair of forceps. The small white larvæ which appear to be those of *Philopotamus* crawl over stones in swift-running brooks, and pupate in their cases made of sand, usually attached to the upper surface of stones. The pupæ, if I remember aright, are protected by a parchment-like case lining the outer one made of sand. I am hoping to find out more of the life history of these insects later, since the habits and œcology of insects should be studied in addition to their structures, in attempting to determine their affinities; but for the purpose of the present paper, it will be sufficient to compare the chief features of their anatomical details with those of the micropterygids.

The head capsule of *Philopotamus* (Plate II, Fig. 2) is surprisingly like that of the micropterygid *Mnemonica* (Fig. 4) in outline, and these two types of head approach the nearest to that of the neuropterous ithoniid *Oliarces clara*, Banks (an insect which should be

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placed in the family Ithoniidæ, judging from the nature of its thoracic sclerites, head capsule, and other features, although this has not yet been done in any grouping of the Neuroptera which I have seen thus far). In fact, it is very probable that the ithoniids are quite like the forms which gave rise to the lines of descent of the Lepidoptera and Trichoptera, though Tillyard and Handlirsch seem to think that the Mecoptera (or their fossil relatives) represent the ancestors of these two groups. The galeæ of the maxillæ (see structures labeled "mx" in Fig. 4, of the micropterygid) are not developed in the Trichopteron shown in Fig. 2, but Ulmer, 1905 (Zoöl. Anz. 28, p. 56) and Cummings, 1913 (Ann. Nat. Hist. XI, p. 308) describe the maxillæ of the Trichopteron *Dipseudopsis* having the parts well developed, and with the galeæ[1] as long as those of *Mnemonica* ("mx" of Fig. 4). The pupa of *Mnemonica* (Fig. 9) has huge crossing mandibles suggestive of the type found in Trichoptera (Fig. 7), but I have not found any Trichoptera in which the mandibles are enlarged at the tips as in *Mnemonica*, nor have any of the trichopterous pupæ which I have examined, a frontal process like that labeled "e" in Fig. 9 of the pupa of *Mnemonica*.

The lateral region of the thorax of *Mnemonica* (Fig. 1) is astonishingly like that of the Trichopteron (shown in Fig. 3), the outlines of the upper and lower divisions of the mesothoracic episternum ("aes_2" and "kes_2") being very similar in both instances. It may be remarked in passing, that the region labeled "aes" is *not* the entire episternum, nor is the region labeled "kes" the trochantin (which is labeled "tn" in both figures) as is usually stated to be the case, and the hinder portions of the coxæ labeled "me" are *not* detached portions of the epimeron "em," which have become adherent to the coxæ—but these features have been thoroughly discussed in an article dealing with the basal segments of the leg in insects (Zoöl. Jahrb. Abt. Anat., 39, p. 1) and need not be gone into further here.

As is true of all Lepidoptera which I have examined, the mesothoracic merocoxa "me_2" (Fig. 1) or posterior division of the coxa extends along the *entire posterior border* of the anterior coxal division "vc_2" in *Mnemonica* (Fig. 1), and there is *no* "*basicoxite*"

[1] The proboscis of *Plectrotarsus* is not "coiled," as was formerly stated to be the case, but is merely folded.

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like that labeled "cm" in the Trichopteron (Fig. 3). On the other hand, the merocoxa "me_2" of Fig. 3 extends only *part way* down the remainder of the coxa in all of the Trichoptera which I have examined, and in all of them *there occurs a mesothoracic basicoxite* "cm" (Fig. 3) *which is absent in all of the Lepidoptera* I have seen. Since these features seem to be constant in the groups under discussion, they are probably diagnostic for the orders in question, and by applying this test to the micropterygids, they are seen to be clearly Lepidoptera and not Trichoptera! I would especially emphasize the importance of this apparently conclusive test, since it is the only feature (of which I have any knowledge) *which holds good in all cases examined*, and on this account it should be of great diagnostic value in attempting to determine whether an insect is lepidopterous or trichopterous.

The tergal region of the thorax is very similar in the lower Lepidoptera and Trichoptera (Figs. 5 and 8), but the mesothoracic scutellum of *Mnemonica* (Fig. 8, "sl_2"), as is the case in most of the other Lepidoptera, tends to become somewhat "transversely oval" in outline, while that of the greater part of the Trichoptera (Fig. 5, "sl_2") is more triangular in outline. This feature may also prove to be of diagnostic value; but I doubt that it will be found to hold in all cases, although I have been unable to find any exceptions thus far. In most Lepidoptera examined, there occurs a tegula-bearing rod labeled "t" in Fig. 8 of *Mnemonica;* but I do not find exactly this type of structure in most of my caddice-fly material. Both of these primitive representatives of the orders Trichoptera and Lepidoptera have a wing-coupling apparatus of the jugo-frenate type (*i. e.* both jugum "j" and frenulum "fr" are present in the insects shown in Figs. 5 and 8) so that Tillyard's distinction between the two orders on this score, will not hold. Since I have not made a study of the wing veins, I shall not attempt to discuss this phase of the matter; but so far as the nature of the jugum-bearing region "jf" and the alar ossicles "np," "ba," "a," etc., are concerned, the basal portions of the wings, like the tergal sclerites, are strikingly similar in the two insects under discussion.

In all of the Trichopterous larvæ which I have examined, homologues of the styli or gonopods ("s" of Fig. 6) are to be found in the posterior region of the abdomen; but I have been unable to find these structures in any lepidopterous larvæ, and since the larvæ of

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the micropterygids seem to lack these structures, this feature may also be of value in distinguishing between the orders Lepidoptera and Trichoptera. The styli labeled "s" in the larva shown in Fig. 6 are apparently represented by the so-called gonopods, or gonostyli "s" of the adult male Trichopteron shown in Fig. 15 (Plate III). Even when the gonopods "h" are well developed in male Lepidoptera (Fig. 13), they apparently retain only one distinct segment "h," while in those Trichoptera in which the gonopods are exceptionally well developed, the gonostyle portion labeled "s" in Fig. 15, usually consists of two distinct segments. Furthermore, the dorsal lobes "sg" are of a different type in the two groups of insects, and these features may be of some value in further distinguishing between the Lepidoptera and Trichoptera.

McLachlan, 1874–1880 (Monographic Revision of the Trichoptera) on page 206 states that "*Enoicyla* is the only authenticated example of terrestrial habits in the larvæ of recent Trichoptera. . . . The genus is scarcely less remarkable by its practically apterous female. . . . The pupæ . . . have very distinct spiracles. . . . The larva lives under moss, etc., at the foot of trees, chiefly in woods, and often at great distances from water." Since some of the larvæ of the micropterygoids feed on mosses (Musci) and occur in somewhat similar locations, these facts lend additional weight to the view that Trichoptera and Lepidoptera are very closely related.

In discussing the protocerebrum of *Micropteryx*, Buxton, 1917 (Trans. Ent. Soc. London, 1917–1918, p. 135) states that "In *Micropteryx* paired ocelli are present, but the median ocellus is not developed here, or in any other Lepidopteron or Trichopteron." This is very probably true of the Lepidoptera as a whole, but I find a median ocellus in many Trichoptera (see Fig. 11 of article on head region of insects in Annals Ent. Soc. America, 1917, p. 339, and Fig. 2 of the present paper). If no median ocellus occurs in any Lepidopteron, and does occur in some Trichoptera, this may be regarded another feature of some value in distinguishing between the orders.

Mr. Banks has called my attention to the fact that "scales" occur on the wings of certain Trichoptera, and their presence is therefore not diagnostic for the order Lepidoptera. Thus McLachlan (l. c. p. 274) in describing the trichopterous genus

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Lepidostoma speaks of the wings of the male as "clothed with scattered black 'scales' regularly placed . . . ," and somewhat similar "scales" occur in certain Leptocerids as well as in the Sericostomatid mentioned above. It must be admitted however, that the "scales" of Trichoptera are not exactly like those of Lepidoptera (see Kellogg, 1895, American Naturalist), though their function in certain cases (*e. g.* androconia-like structures of *Mystacides* wing, described by Kellogg, 1895) may be very like that of the scales of Lepidoptera.[1] Cummings, 1914 (Proc. Zoöl. Soc. London, 1914, p. 461) states that "The occurrence of typical unicellular scent glands at the bases of hairs in Trichoptera as well as Lepidoptera is interesting, and in view of the close relationship between these two orders not wholly unexpected. . . . In *Sericostoma* they (scales) occur on the maxillary palpi, a position in which, I believe, they are undescribed in Lepidoptera." The absence of scales from the maxillary palpi in all Lepidoptera and their presence in some Trichoptera, may prove to be another distinguishing feature in defining the two orders.

From the foregoing discussion it is quite evident that the similarity in the head capsule, the general character of the mouthparts (both adult and pupal), the nature of the thoracic sclerites, the wing venation and presence of a coupling apparatus of the primitive jugo-frenate type, the general character of the terminal abdominal structures, and the occurrence of moss-inhabiting larvæ, are features indicating an extremely close relationship between the lowest Lepidoptera and Trichoptera, so that Comstock's removing the micropterygoids from the Lepidoptera to the Trichoptera has considerable justification. On the other hand, the subdivision of the mesothoracic coxa *for its entire length*, into eucoxa "vc" and merocoxa "me" (Fig. 1) in all Lepidoptera studied, and the *merely partial* subdivision of the mesothoracic coxæ of all Trichoptera examined (Fig. 3 "vc" and "me"), together with the presence of a basicoxite "cm" (Fig. 3) marked off by a downward-sweeping line of demarcation in the mesothoracic coxa of all Trichoptera studied, and the absence of this type of structure in all Lepidoptera examined furnish us with an appar-

[1]Busck, 1914 (Proc. Ent. Soc. Washington, 16, p. 50), calls attention to the fact first observed by Spuler, that if the scales are removed from the wing of a micropterygid, its surface is seen to be covered with minute curved spines (like those of Trichoptera) occurring "between the scales and much more numerous than these."

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ently decisive test for determining whether an insect is lepidopterous or trichopterous, and when this test is applied to the micropterygoids, they are seen to be clearly lepidopterous, not trichopterous! The "transversely ovate" outline of the mesothoracic scutellum (Fig. 8, "sl_2") in most Lepidoptera as opposed to the triangular scutellum of most Trichoptera (Fig. 5, "sl_2"), the absence of a median ocellus in all known Lepidoptera and its presence in some Trichoptera, the presence of "scales" on the maxillary palpi of some Trichoptera and their absence in all known cases in Lepidoptera, and the presence of structures homologous with the posterior abdominal styli in all trichopterous larvæ examined, coupled with the absence of such structures in lepidopterous larvæ are features of value serving to support the above mentioned test, when applied to the micropterygoids, and the evidence furnished by these features (which seem to have a very general application throughout the two orders) should be conclusive. I would therefore maintain that the micropterygoids are lepidopterous, not trichopterous, although I too would emphasize the remarkably close relationship between the lower Lepidoptera and Trichoptera (See Trans. Ent. Soc. London, 1919, p. 93).

In the appended diagram (text figure 1) the lines of descent of the Lepidoptera and Trichoptera are represented as though diverging from a common Lepidoptero-Trichopteron stem composed of forms combining in themselves the primitive ancestral features of the two orders. Just after these two lines of descent begin to diverge as they emerge as distinct orders (the common stem, however, was probably trichopterous) the line of development of the micropterygoids appeared, carrying over from the common ancestry many primitive features occurring in the Trichoptera, yet exhibiting certain peculiarly lepidopterous characters. The line of development of such Trichoptera as *Philopotamus* likewise arose very near the point of origin of the micropterygoid line of development, as shown in the diagram, but since *Philopotamus*' line of development is on the side of the Trichoptera, it did not acquire any peculiarly lepidopterous features, though it has developed certain features in common with all other Trichoptera, as would naturally be expected. This simple and self-evident explanation will serve to show how the micropterygoids may be truly Lepidoptera, and the *Philopotamus*-like forms may be truly

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Trichoptera, despite the fact that both micropterygoids and lower Trichoptera exhibit a remarkable degree of similarity; and it is therefore quite evident that it is not necessary to remove the micropterygoids from the Lepidoptera to the Trichoptera, nor is it necessary to regard them as representing a distinct order.

It has seemed unnecessary to append a "bibliography" at this point, since the more important reference works dealing with the anatomy on the insects in question have been given in the text of this article. If the reader is interested in the further study of the anatomy of the micropterygoids, the following works, in addition to those previously cited, may be of interest. Walter, 1885 (Jen. Zeit. f. Wiss., 8, p. 755), on the mouthparts; Tillyard, 1918, Proc. Linn. Soc. N. S. Wales, xliii, pp. 298, and 626, for wing structures; and the excellent general description of the anatomy of all stages of *Mnemonica*, by Busck and Böving, 1914 (Proc. Ent. Soc. Washington, 16, p. 151).

The following list of abbreviations applies to the figures of Plate IV (illustrating the following article on genitalia of higher insects) as well as to the plates of the present paper, and will therefore serve equally well for both articles. Since homologous structures bear the same label throughout the series of figures, it will be unnecessary to give a more detailed description of the various anatomical features of the insects under discussion.

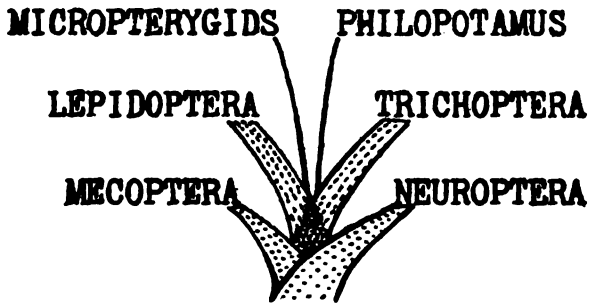

Fig. 1. Lines of descent of Lepidoptera and Trichoptera.

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Abbreviations (Plates II, III, IV).

a.....posterior notal wing process (adanale).
aes.....upper division of episternum (anepisternum).
b .....thread of penis (penisfilum).
ba .....wing ossicle at base of anal veins (basanale).
c.....clypeus.
ca.....cerci.
cm.....coximarginal sclerite (basicoxite).
cx.....coxa.
d .....tergal plate and setæ of ninth segment.
e.....frontal process (frontonasus).
em.....epimeron.
ep.....epiproct (uncus, tegumen, or pygidium), also proctiger or structure bearing anus.
eps.....epipodal setæ.
es.....epicranial suture.
f.....frons.
fp.....frontal (tentorial) pits.
fr.....frenulum.
g....."stipes" of gonopods (gonostipes).
gp .....genal process.
h .....harpago or clasp; last segment of gonopod, also called "harpes" and cochlearium.
ha .....hypandrium, or plate under genital apparatus of male.
ip.....interpleurite.
j.....jugum, or "clavus."
jf.....jugum-bearing region (jugifer).
kes.....lower division of episternum (katepisternum).
l.....labrum.
lc.....lateral cervical plates.
lp.....labial palpus.
ls.....laterosternite.
m.....median wing ossicle (mediale).
md.....mandible.
me.....posterior division of coxa (merocoxa, or meron).
mp.....maxillary palpus.
mx.....maxilla.
np .....notal wing ossicle (notopterale).

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o.....ocelli.
p .....styliger or "coxite" bearing styli (also called cardo, or gonocardo).
pa .....parietal region of head, prealar bridge of thorax.
pc.....postcranial region of head.
pf.....parafrons.
pfi .....paranotal fringe (parafimbrium).
pl.....propleuron.
pn .....pronotum.
pp .....gonopleurite.
pr.....plates on either side of anus (paraprocts or parapodial plates).
ps.....podal setæ.
psl.....postscutellum.
pt.....patagium, or patagial areas.
pv .....penisvalvæ, penis, ædeagus or phallus.
s.....styli, or gonopods (gonostyles).
sa.....plate under wing (subalare).
sal .....anterior tergal wing process (suralare).
sc.....scape of antenna.
sct.....scutum.
sg.....process above gonopod (surgonopod) probably homologous with dorsal lobes rather than cerci.
sl.....scutellum.
t.....tegula-bearing rod (tegulifer).
tf.....terminal filament (telofilum).
tg.....tegula.
tn.....trochantin.
vc.....anterior division of coxa (eucoxa or veracoxa).

Explanation of Plates II and III.

Fig. 1. Lateral view of thorax of *Mnemonia auricyanea*, Wals. (Micropterygoid).

Fig. 2. Frontal view of head of *Philopotamus distinctus* (Trichopteron).

Fig. 3. Lateral view of thorax of *Philopotamus*.

Fig. 4. Frontal view of head of *Mnemonica auricyanea*, Wals.

Fig. 5. Dorsal view of thorax and wing bases of *Philopotamus*.

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Fig. 6. Lateral view of terminal structures of larval Trichopteron.

Fig. 7. Frontal view of pupal head of *Philopotamus* only mandibles shown.

Fig. 8. Dorsal view of thorax and wing bases of *Mnemonica auricyanea*, Wals.

Fig. 9. Frontal view of pupal head of *Mnemonica auricyanea*, Wals.

A COMPARISON OF THE GENITALIA OF MALE HYMENOPTERA, MECOPTERA, NEUROPTERA, DIPTERA, TRICHOPTERA, LEPIDOPTERA, HOMOPTERA, AND STREPSIPTERA, WITH THOSE OF LOWER INSECTS.

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Since the same plates have been used to illustrate both the present paper, and the preceding one dealing with a comparison of the lower Lepidoptera with the Trichoptera, the same list of abbreviations will serve for both papers, and by referring to the explanation of the labeling, given on page 32, this will obviate the necessity of repeating in the present paper, the list of abbreviations there given. For the Strepsipteron here described, I am indebted to Dr. C. T. Brues. Dr. Bethune-Baker has loaned me the lepidopterous material used; Dr. R. J. Tillyard has furnished the neuropterous material; and Mr. S. A. Rohwer has furnished the sawfly material used in the preparation of this paper. Mr. Nathan Banks has very kindly identified the Trichopteron referred to, and Mr. A. N. Caudell has had the Homoptera identified for me. To all of these gentlemen, I would express my deep appreciation of their generosity and assistance so freely given.

The genitalia of male insects have been discussed in several recent articles; but the correct interpretation has not been given to the parts in all cases. Recently, however, I have been able to examine a far wider and more inclusive range of forms than was at first available for study, and the added evidence, together with that furnished in Dr. Walker's excellent account of the parts of the

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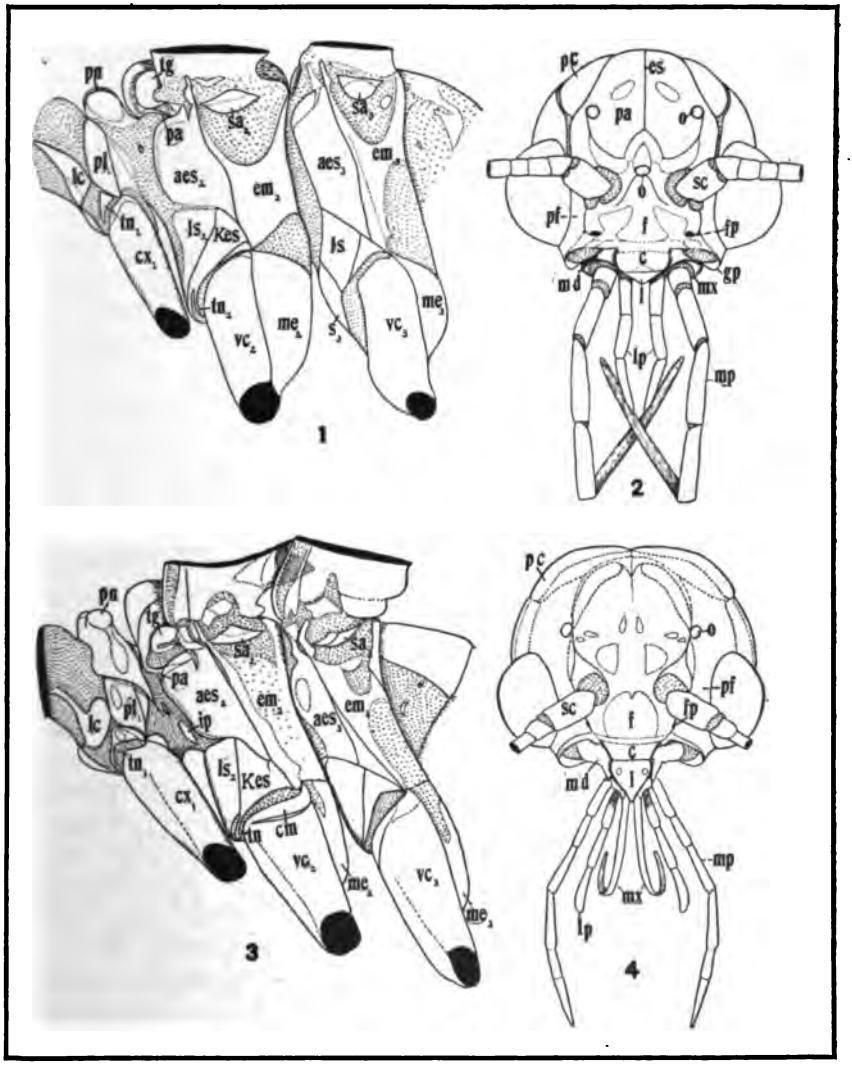

CRAMPTON—Lower Lepidoptera and Trichoptera.

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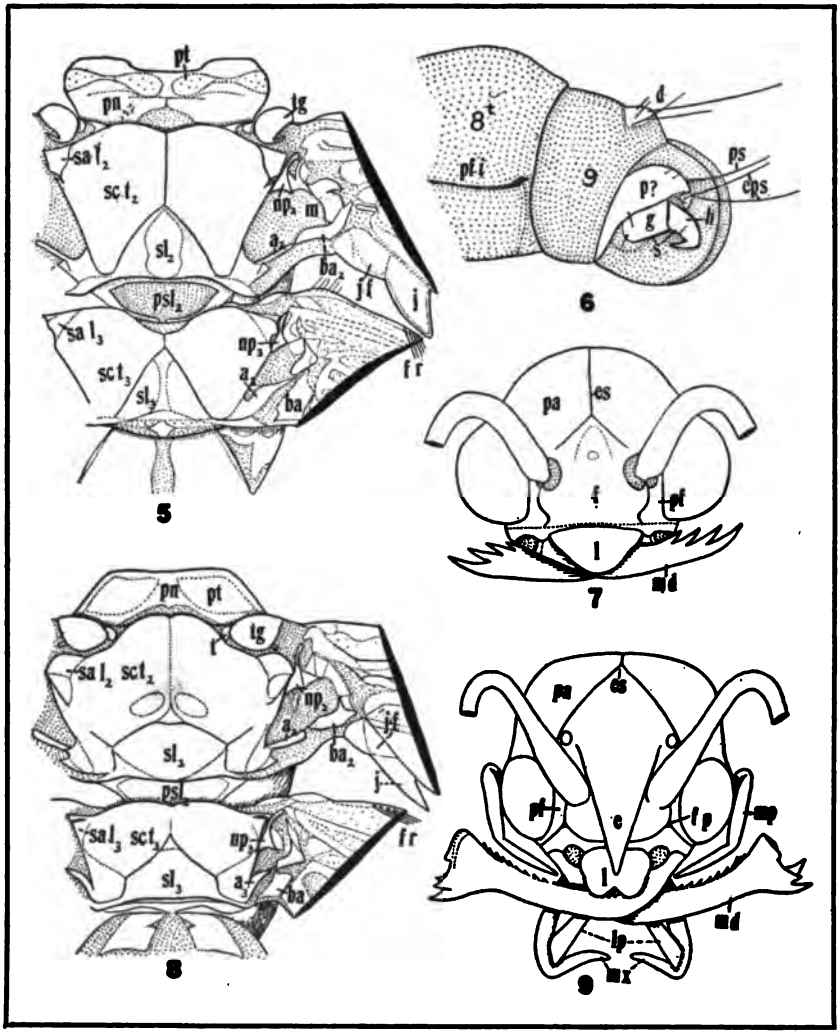

CRAMPTON—Lower Lepidoptera and Trichoptera.

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male of the interesting insect *Grylloblatta campodeiformis*, has made it possible to revise the interpretation of the parts in the higher forms, in the light of the increased knowledge of the subject, gained from these sources.

For the purpose of the present paper, it is sufficient to begin the study of the modifications met with in the higher forms with a consideration of the condition exhibited by the primitive mayfly *Blasturus cupidus* (Fig. 11). The sternite of the ninth abdominal segment in this insect (labeled "ha" in Fig. 11, Plate IV) bears a pair of somewhat closely united, plate-like sclerites, called the styligers or "coxites," one of which is seen in profile in Fig. 11, where it bears the label "p." Dr. Walker correctly compares these styligers or "coxites" with the basal segments of abdominal limbs (protopodites ?) retained in such lower insects as *Machilis*, in which the styligers or "coxites" bear styli which are possibly homologous with the exopodites (or epipodites ?) of crustacean limbs. Similarly, in *Blasturus*, the styligers or "coxites" labeled "p" in Fig. 11, bear styli "s"; but in the latter insect, there are traces of two segments in the styli (and in some mayflies there are three or more segments in the styli), while the styli of most apterygotan insects are composed of but one segment. The segmented styli of ephemerids ("s" of Fig. 11) are called gonopods, gonostyli, or arthrostyli. Following Morgan, 1913, Eaton (Monograph of the Ephemerida), Berlese, 1909, and others who have figured the parts of male ephemerids, I formerly interpreted the plates "p" of Fig. 11 as representing the sternite of the tenth segment; but they are apparently structures belonging to the ninth segment, as pointed out above. In this connection, it should be noted that the designation "tenth segment" refers to the tenth *abdominal* segment, not including the three thoracic segments in the count, as is usually done by lepidopterists. Furthermore, it should be borne in mind that the actual first abdomnial sternite has become atrophied in most insects, and the first apparent sternite really represents the sternite of the second abdominal segment, so that it is preferable to count the segments on the dorsal side, where most of them are preserved in the lower forms.

Palmen, 1884 (page 42) in describing the development of the vasa deferentia of mayflies, states that they extend to the posterior

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margin of the ninth sternite where they are inserted in the hypodermis. On page 47, he states that the penes (here homologized with the penis valves "pv") arise as two protuberances of the hypodermis in the location of the insertion of the vasa deferentia (*i. e.* on the posterior margin of the ninth sternite), so that the partially united appendages (labeled "pv" in Fig. 11) lying above and between the gonopods "s," and forming the phallus or penis of the male *Blasturus* may represent appendages of the ninth segment in addition to the gonopods "s." If both penes and gonopods are structures belonging to the ninth segment in such primitive forms as the mayflies, this fact is of considerable importance in attempting to determine to what segment structures homologous with them in the higher forms may be assigned; and this also has some bearing on the view that the penis valves "pv" represent the endopodites of a pair of abdominal limbs whose exopodites are formed by the gonopods "s," since in order to fulfil the latter conditions, both penis valves and gonopods would have to belong to the same segment—for it is clearly impossible for the exopodites of a pair of limbs to belong to one segment while the endopodites of the same limb belong to another segment. On the other hand, Wheeler, 1893 (p. 124) states that "the male ducts of *Blatta* end at first in terminal ampullæ enclosed by the appendages of the tenth abdominal segment just as in *Xiphidium*" but later "the terminal ampullæ lie completely in the ninth segment, having shifted their position headward" (p. 118). On page 132 he states that in *Xiphidium* and *Blatta* the male ampullæ lie "at the hind end of the ninth abdominal segment. Just as the deferent ducts of ephemerids extend to the penes and open to the exterior, so the terminal ampullæ originally extend into a pair of appendages, albeit on the tenth segment and not opening to the exterior. If the penes of the ephemerids are really modified ambulatory appendages they would be homologous with the styli of Orthoptera. The curious persistence of these appendages in existing Orthoptera may be due to their having once functioned as penes, long after the other abdominal ambulatory appendages have disappeared." While I would not agree with Wheeler in his suggestion that the penes of the ephemerids (which are apparently homologous with those of the blattids) represent the styli of the Orthoptera (*i. e.* that "pv" of Fig. 11 represent

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"s" of Fig. 12), there is some reason to suppose that styliform appendages borne on the tenth abdominal segment of certain Trichopteron larvæ (see Plate III, fig. 6, "s") may take part in the formation of portions of the genitalia of the adult male, although this matter is greatly in need of further investigation.

The tenth tergite labeled "ep" in Fig. 11, overlaps the paraprocts "pr" which are situated on either side of the anal opening, and bear the cerci "ca." The paraprocts "pr" are latero-ventral structures of the eleventh segment, and are usually interpreted as representing the divided sternite of this segment, although it is quite possible that they represent the protopodite of the uropod whose endopodite forms the cercus. The eleventh tergite of the ephemerid shown in Fig. 11 bears a terminal filament or telofilum "tf." The eleventh tergite is usually atrophied in the higher forms, while the paraprocts "pr" usually unite with the tenth tergite "ep" to form a structure through which the anus opens (*i. e.* the "proctiger" of higher insects).

In the blattids (whose parts are of the type serving as the "starting point" for the modifications developing in the various orthopteroid insects) the styli-bearing plates "p" of Fig. 12, are usually indistinguishably united with the ninth sternite "ha," although in the roach shown in Fig. 12, traces of these plates are still retained. The styli, "s," however, usually remain distinct even after the plates bearing them have become indistinguishable fused with the ninth sternite. The penis valves "pv" of Fig. 12, possibly represent the paired organ "pv" of the ephemerid shown in Fig. 11, although the parts are asymmetrically developed in the roach. The tenth tergite "ep" is distinct in most blattids, as is also true of the paraprocts "pr" (Fig. 12); but the eleventh tergite is atrophied in these insects and their immediate relatives.

A different path of specialization is apparently followed in the higher insects although the condition occurring in these forms is probably a modification of the basic plan exhibited by the Ephemerida (Fig. 11). Thus in the Prohymenopteron (sawfly) shown in Fig. 17, the tergite of the ninth segment "9^t" becomes very small, while the sternite of the ninth segment is very large, and projects beneath the genitalia of the male to form the so-called hypandrium "ha." The tenth tergite "ep" is very small, and the paraprocts "pr" of Fig. 11, which bear the cerci "ca," have united with the

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tenth tergite "ep" in the sawfly shown in Fig.17. In most sawflies, the ninth tergite "9t" is greatly reduced, and the tenth tergite "ep" (Fig. 17) unites with it. In the siricid shown in Fig. 17, the basal sclerite "p" (interpreted as the tenth sternite by some entomologists) may possibly represent the plate labeled "p" in Fig. 11 of the ephemerid—though it is also possible (but not as probable) that the segment "g" of the genital claspers of the siricid shown in Fig. 17 represent the styligers "p" of the ephemerid (Fig. 11). In either case, the styliger region "p" of the sawfly (Fig. 17) would be distinct from the ninth sternite "ha" thus approximating the condition exhibited by *Grylloblatta campodeiformis*, which Walker considers unique in having styligers distinct from the ninth sternite. The two-segmented clasping forceps "s" composed of the segments labeled "g" and "h" in the sawfly shown in Fig. 17, may represent the claspers labeled "s" (and also composed of two segments labeled "g" and "h"—which however may not be the exact homologues of the segments bearing these labels in Fig. 17) in Fig. 11 of the ephemerid.[1] The penis valves "pv" composing the penis or phallus in the sawfly shown in Fig. 17, doubtless represent the penis valves "pv" of the ephemerid shown in Fig. 11. The sawfly group, or Prophymenoptera, is thus seen to have retained the primitive condition of the parts as nearly as any of the higher forms have done, and a study of the parts in the sawflies is therefore of considerable importance.

In the Mecopteron shown in Fig. 19, the tergite labeled "ep" doubtless represents the tergum of the ninth segment, while the tenth tergite has either united with it, or has become greatly reduced. The ninth sternite "ha" is well developed, and the gonopods are composed of two segments "g" and "h" which are possibly homologous with those bearing the same labels in Fig. 17. The sclerite labeled "p" in Fig. 17 apparently unites with the pleural region of the ninth segment in the Mecoptera (Fig. 19); and in the insect shown in Fig. 19, the penis valves, which are usually separate in the lower forms, have probably united to form the single membranous structure "pv." In the Mecopteron shown in Fig. 21, the plate "pp" represents the ventral and lateral portions of the ninth segment, while the ninth tergite becomes prolonged into two lobe-like processes labeled "sg," which are

[1] The parameres of Dermaptera and Coleoptera are also homologous with these structures.

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extremely elongate in some *Bittacus*-like Mecoptera, and doubtless serve as clasping organs in mating. The basal segment "g" of the gonopods is very large in the Mecopteron shown in Fig. 21, while the terminal segment "h" is greatly reduced. The penis valves "pv," however, are quite large, are partially united, and bear a coiled penisfilum "b." The structure labeled "ep" probably represents the tenth tergite with which the paraprocts bearing the cerci "ca" have united. The structures labeled "ca" may not represent the cerci; but they occupy the position characteristic of these organs, and have been provisionally interpreted as the cerci in the present paper.

In the Strepsipteron shown in Fig. 18, the structure labeled "ep" is a "proctiger," since the anus opens at its posterior end. It is probably formed largely by the tenth tergite, although a portion of the ninth tergite may also be involved in its composition. The structure labeled "g" may represent the hypandrium or plate below the genitalia of the male (*i. e.* the ninth sternite) but I am inclined to think that the basal segment of the gonopods also enters into the composition of this structure, while the small hooks labeled "h" might possibly represent the terminal segments of the gonopods. The structure labeled "pv" is the ædeagus or phallus, and in some Strepsiptera an intromittent organ is protruded from the ædeagus at the time of mating.

The sternite of the ninth segment labeled "ha" in the Neuropteron shown in Fig. 20 is well developed and is demarked from the pleural region of the segment "pp." The ninth tergite is partially produced on either side to form a pair of lobe-like structures "sg," comparable to the copulatory lobes "sg" of the Mecopteron shown in Fig. 21. The structure labeled "ep" in Fig. 20 probably represents the tenth tergite, or the fusion product of the tenth tergite and the paraprocts (or plates on either side of the anus). I formerly interpreted the structures labeled "s" in Fig. 20, as the penis valves (*i. e.* "pv" of other insects, Figs. 17, 21, etc.); but there are some grounds for considering the structures "s" of Fig. 20, as the remains of the gonopods labeled "s" (which are composed of the segments "g" and "h" in other insects), or a portion of it, in the other figures, and I have provisionally adopted the latter interpretation in the present paper.

In the psyllid shown in Fig. 14, the tergal sclerites labeled 6

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and 7, probably represent the eighth tergite, and the structure labeled "ep" bears the anus at its tip (*i. e.* it is a "proctiger"). The proctiger "ep" probably represents the tenth tergite united with the ninth, although the embryology of these insects would have to be studied in order to definitely determine what segments enter into the composition of the structures in question. The structure labeled "g" is here interpreted as representing the united basal segments of the gonopods (labeled "g" in other figures—as in Fig. 21 for example) though it may also include the ventral plate "ha" of other insects as well. The forceps "h" of Fig. 14 apparently represent the distal segments of the gonopods "h" of other figures. All that remains of the phallus or ædeagus, is the slender bowed structure "pv," which bears a terminal articulated appendage or "telædeagus" fitting into the groove on the lower (posterior) surface of the proctiger "ep." In the fulgorid shown in Fig. 16, the structure bearing the label "8?" probably contains the ninth segment; but it appears to be the eighth. The dorsal structure labeled "ep" is apparently formed in great part by the ninth tergite which has probably united with the tenth tergite, and has grown downward and posteriorly below the anal opening. The structure "ep" is thus a "proctiger" rather than an "epiproct," though either term might be applied to it. The forceps "s" of Fig. 16 represent either the styli (gonopods) of other figures (labeled "s") or they represent portions of these styli (gonopods); and the inner structures "pv" which they enclose, are probably homologous with the penis valves "pv" of other insects. It is quite possible that the structure "ep" of Fig. 16 may represent a union of the structures labeled "sg" and "ep" in Fig. 20; but I have been unable to determine this point.

The tergal region "ep" of the Trichopteron shown in Fig. 15 probably represents the ninth, or the united ninth and tenth tergites, while the lateral lobes "sg," are apparently homologous with the copulatory lobes "sg" of Figs. 20 and 21. The structure labeled "pv" in Fig. 15 is the ædeagus or phallus, and is possibly composed of the united penis valves of certain other forms. The gonopods "s" of Fig. 15 are two-segmented (*i. e.* are made up of segments "g" and "h") and are apparently homologous or homodynamous with the styli "s" (also composed of two segments

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"g" and "h") of the trichopterous larva shown in Fig. 6(Plate III). The basal plate "p" of Fig. 6 (Plate III) has been provisionally homologized with the styli-bearing plate "p" of Fig. 11 (Plate IV) but this may prove to be incorrect. While it is quite probable that the gonopods "s" of the adult Trichopteron shown in Fig. 15 (Plate IV) are homodynamous, or serially homologous, with the gonopods labeled "s" in Fig. 6 (Plate III) of a larval Trichopteron, in the sense that the legs of the mesothorax are serially homologous (homodynamous) with those of the metathorax, the two structures in question may not be *absolutely* homologous, since the gonopods or styli labeled "s" in the larval Trichopteron (Fig. 6, Plate III) are apparently borne on the *tenth* segment, as is also true of the styli in certain larval sawflies, while the gonopods of the adults may not belong to the tenth segment. The question naturally arises as to whether the styli borne on the tenth segment of the larval Trichopteron ("s" of Fig. 6, Plate III) form the gonopods "s" of the adult (Fig. 15, Plate III) or whether they represent the penis valves which unite to form the phallus of the adult. The observations of Wheeler, 1893, who maintains that the penis valves are appendages of the tenth segment, would lend weight to the latter view; but it is much simpler to refer to both styli "s" of larvæ (Fig. 6, Plate III) and gonopods "s" of adult insects (Fig. 15, Plate IV) as gonopods or gonostyles regardless of the segment to which they belong; and for the sake of convenience, this method has been adopted in the present discussion.

The dorsal region "ep" of the Lepidopteron shown in Fig. 13, represents either a posterior prolongation of the ninth tergite, or the fusion product of the tenth tergite with the ninth. The lateral lobes "sg" are probably homologous with the copulatory lobes "sg" of Fig. 21, or the lateral lobes "sg" of the Trichopteron shown in Fig. 15. The structure labeled "pv" in the Lepidopteron (Fig. 13) is the phallus or ædeagus, and the filament "b" possibly represents the coiled filament "b" of Fig. 21. The harpago "h" of the Lepidopteron is possibly the terminal segment of the gonopod, whose basal portion has united with the ninth abdominal segment; or the harpago "h" may represent the whole gonopod "s" of Fig. 15, although the former explanation is the more probable one. The dorsal structure "ep" of the Lepidopteron (Fig. 13) is some-

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times called the uncus or tegumen, and a ventral prolongation possibly homologous with the lower portion of the structure labeled "ep" in Fig. 16 is sometimes called the scaphium in Lepidoptera.

In the Dipteron shown in Fig. 10, the dorsal plate "ep" is probably the tergite of the ninth segment alone; but I am not sure of this point. The elongate slender processes "sg" resemble cerci; but I am more inclined to regard them as lateral processes of the ninth tergite possibly homologous with the lateral lobes "sg" of Fig. 21, and I have therefore referred to them as the surgonopods in the following discussion. They are possibly homologous with the structures referred to as "gonopods" in such Neuroptera as *Ithone* (See Crampton, 1918a Fig. 14); but these structures in both cases are probably homologous with the parts termed surgonopods in the insects described in the present paper. I would likewise use this opportunity of calling attention to the fact that the lateral plates called paraprocts in the paper referred to above as dealing with the Neuroptera, etc. (Crampton, 1918a) are not the true paraprocts "pr" of Figs. 11, 12, etc., but are homologous with the lateral plates of the ninth segment called gonopleurites in the present paper ("pp" of Figs. 20, etc.). The basal segment of the gonopods labeled "g" in Fig. 10 has probably united with the pleural region to form the apparent basal segment "g," while the distal segment "h" is distinct and well developed. The terminal portions of both gonopods "h" and surgonopods "sg" bear short spine-like structures which are apparently of use in enabling the forceps-like structures to hold more securely. The sternite of the ninth abdominal segment "ha," forms a hypandrium or plate below the genitalia of the male, as in the Neuroptera and sawflies.

The principal points brought out in the preceding discussion may be briefly summarized as follows. The epiproct, or plate above the anal opening ("ep" of Figs. 11, 17, etc.) is usually formed by the tenth tergite, or the tenth united with the ninth tergite (or a portion of it). In some cases the region above the anal opening may grow downward on either side, or unite with other regions to form a proctiger ("ep" of Fig. 16?) through which the alimentary tract opens. Lateral prolongations of the ninth tergite form the surgonopods "sg," or dorsal structures frequently employed as upper claspers in mating. The pleural plates of the

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ninth abdominal segment form the gonopleurites "pp," while the sternite of the ninth segment usually forms the hypandrium "ha" or plate below the genitalia of the male. When the cerci "ca" are present, they are borne on a region representing the union of the paraprocts of the eleventh segment ("pr" of Fig. 12) fused with the tenth tergite, as in Fig. 17, and this in turn may unite with the ninth tergite. In the lower insects a pair of styli "s" or gonopods is attached to the posterior margin of the hypandrium (ninth sternite), or plate below the genitalia of the male. In higher insects a pair of styli (gonostyli, or gonopods) forms the outer ventral pair of claspers "s" between which the penis valves "pv" or phallus are situated. The only structures which one can compare with these gonostyli or gonopods in larval insects, are borne on the tenth sternite (Fig. 6, "s") as in larvæ of Trichoptera, certain sawflies, etc.

From a study of the wing veins, and head region, I formerly maintained that the Homoptera (and Hemiptera) are somewhat more closely related to the insects grouped about the Psocidæ than to those grouped about the Neuroptera. The thoracic sclerites of the Homoptera, however, are very like those of the Neuroptera, and the genitalia of the male Fulgoriadæ, Psyllidæ, etc., here studied would bear out the view that the Homoptera are more closely allied to the Neuroptera and other Neuropteroid insects such as the Mecoptera, Lepidoptera, etc. The nature of the genitalia of the Strepsiptera would tend to confirm the contention that these insects are quite closely related to the Homoptera, such as the Psyllidæ, etc., although they show considerable resemblance to the Mecoptera and other Neuropteroid insects. The genitalia of the Diptera are like those of the Mecoptera and Trichoptera, and the lower Trichoptera are very similar to the lower Lepidoptera, as one would expect from a study of other features than the genitalia. The genitalia of the sawflies are as much like those of the Mecoptera as any insects, although they exhibit some resemblances to the genitalia of the Diptera also. In the main, the study of the genitalia of the higher insects would serve to substantiate the evidences of relationships furnished by other anatomical structures, and it would therefore be in harmony with the views concerning the interrelationships of the insects related to the Neuroptera, recently published in the Transactions of the Entomological Society of London (Crampton, 1919a).

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Abbreviations.

For list of abbreviations employed in the labeling of the figures used to illustrate the present paper, see page 32.

Explanation of Plate IV.

Fig. 10. Lateral view of terminal abdominal structures of the tipulid Dipteron *Bittacomorpha* sp.
Fig. 11. Lateral view of terminal structures of the ephemerid *Blasturus cupidus*.
Fig. 12. Same of the Blattid *Cryptocercus punctulatus*.
Fig. 13. Same of the Lepidopteron *Eriocrania calthella*.
Fig. 14. Same of the psyllid Homopteron *Psylla* sp.
Fig. 15. Same of the Trichopteron *Philopotamus distinctus*.
Fig. 16. Same of the fulgorid Homopteron *Ormenis pruinosa*.
Fig. 17. Same of the sawfly *Sirex edwardsii*.
Fig. 18. Same of the Strepsipteron *Xenos pallidus*.
Fig. 19. Same of the Mecopteron *Boreus nivoriundus*.
Fig. 20. Same of the Neuropteron *Nymphes myrmeleonides*.
Fig. 21. Same of the Mecopteron *Bittacus pilicornis*.

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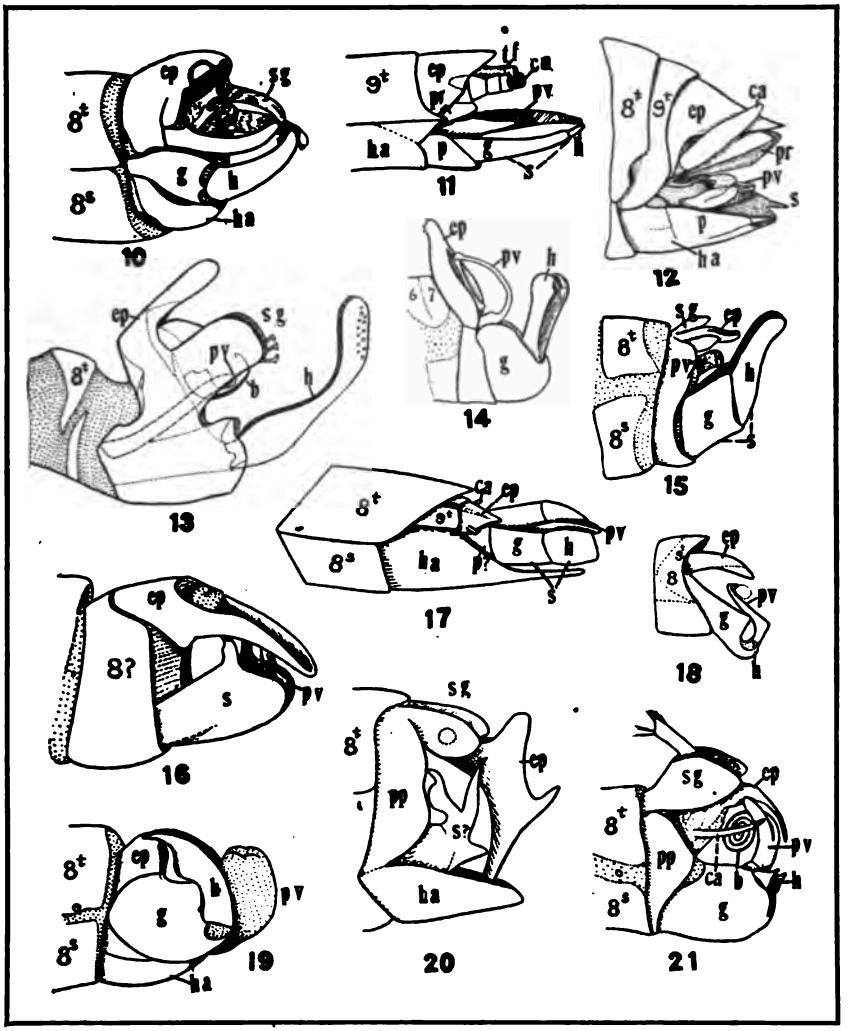

CRAMPTON—Genitalia of Insects.

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THE SUBFAMILIES OF FORMICIDÆ, AND OTHER TAXONOMIC NOTES.[1]

By William Morton Wheeler.

A comparison of the seventh volume of Dalla Torre's "Catalogus Hymenopterorum," which summarizes what was known of the classification of the Formicidæ down to 1890, with any very recent monograph of these insects, gives the impression that there has been no change in expert opinion concerning the limits of the family and its subfamilies during the past thirty years. Dalla Torre recognizes five subfamilies, the Dorylinæ, Ponerinæ, Myrmicinæ, Dolichoderinæ and Camponotinæ and the same groups are retained in Emery's contributions to the "Genera Insectorum" (1910–'13), so far as published, and in his recent sketch of the classification of the Myrmicinæ (1914). Between the appearance of the "Catalogus" and the works just mentioned, however, Emery, who has shown greater interest than other myrmecologists in the definition of taxonomic categories above the rank of the genus, proposed an additional subfamily, the Pseudomyrminæ in 1899, and in 1895 transferred a group of genera, comprising the tribe Cerapachyini, from the Ponerinæ, where it had been placed by Forel in 1893, to the Dorylinæ. After Forel and I had objected to this proceeding, Emery, in the "Genera Insectorum" (1913) returned the Cerapachyini to the Ponerinæ, but gave them the rank of a section, the Prodorylinæ. He had long since reunited the Pseudomyrminæ with the Myrmicinæ. In his most recent sketch of the classification of this subfamily (1914) he unites the tribes Metaponini and Pseudomyrmini as the first section, the Promyrminæ, and places all the other tribes in a second section, the Eumyrmicinæ. Thus in 1920 the five subfamilies have again acquired the limits which they had in 1890.

During the past year a study of ant-larvæ, representing more than a hundred genera and many subgenera of all five subfamilies, has convinced me that Emery was right in 1899, when he regarded the Pseudomyrminæ as constituting an independent subfamily. I am also of the opinion that the Cerapachyini should be removed

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 169.

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from the Ponerinæ and raised to the rank of an independent subfamily, between the Dorylinæ and Ponerinæ. A number of reasons may be adduced for making these changes.

In 1899 Emery, after a comparative study of the larvæ of several Formicid genera, concluded that "Those of *Sima* and *Pseudomyrma*, besides their extremely hypocephalic development, exhibit a very special character in the presence of rudiments of antennæ. I believe that this very noteworthy fact, together with the well-known peculiar characters of the head of the imagines, will justify the separation of these genera from the remainder of the Myrmicinæ, to form the new subfamily of the Pseudomyrminæ." My study of numerous species of this group, which now embraces four genera, *Tetraponera* Smith (=*Sima* Roger), *Pachysima* Emery and *Viticicola* Wheeler of the Old and *Pseudomyrma* Lund of the New World, shows that Emery was far from realizing the full import of their larval characters. Not only have the larvæ peculiar long, straight, cylindrical, distinctly segmented bodies with blunt anterior and posterior ends, a large, usually subquadrate head, ventrally placed and with rudiments of antennæ (which are also present in the larvæ of many other ants, notably in the Ponerinæ), but the thoracic and first abdominal segments are furnished with peculiar exudatory papillæ (exudatoria), which form a cluster around the mouth. I have described and figured these organs in *Viticicola* and *Pachysima* (1918b) and have shown that they have the form of extraordinary appendages in the first larval stage (trophidium) of the two known species of the latter genus, and that the swollen ventral portion of the first abdominal segment, just behind the mouth, forms a pocket in which the workers place a pellet of food. The exudatoria, the pocket, which I call the *trophothylax*, and the unusual method of feeding are characteristic of all four genera and no distinct traces of such conditions have been found in any other ant-larvæ.

More recent study has added two very interesting facts, which, in advance of a complete account to be published in collaboration with my colleague, Prof. I. W. Bailey, may be briefly considered in this place. The food pellet proves to be merely the small pellet ("corpuscule enroulé," or "corpuscule de nettoyage" of Janet) which the worker ant moulds in its own infrabuccal pocket and consists of the solid food-particles from which the juices are

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sucked, *plus* the various particles collected by the ant by means of the strigils of the fore tibiæ from the surfaces of the antennæ and other parts of the body and carried into the infrabuccal pocket after being wiped off by the maxillæ. Other ants eventually spit out the pellet which is commonly a moulded, subspherical conglomerate of diverse particles, such as small pieces of insects, fragments of plant tissue, fungus spores and hyphæ, pollen grains, etc., and cast it away as refuse, but the worker nurses of the Pseudomyrminæ place it as pabulum in the trophothylax of the larva!

Even this, however, is not the whole story. An examination of the mouth of the larva reveals a singular structure, evidently used for reducing the food pellet to such a finely divided state that it can, when acted on by the digestive juices of the mesenteron, yield a certain amount of nutriment, which the worker ant could not extract from it while it was in the infrabuccal pocket. This larval structure, which may be called the *trophorhinium*, consists of two flat, opposable plates, the dorsal and ventral surfaces of the buccal cavity, each furnished with very fine, parallel, transverse-striæ or welts, which, under a high magnification are seen to be made up of minute chitinous projections or spinules. The ventral usually has more numerous rows of spinules than the dorsal surface. The two surfaces are evidently rubbed on one another and thus triturate the substance of the food pellet, only small portions of which are ingested at a time from the trophothylax. In all Pseudomyrmine larvæ and in many larvæ of the other subfamilies, except the Dorylinæ and Cerapachyinæ, the trophorhinium is beautifully developed, although in many ants (Ponerinæ) it may be used for comminuting parts of insects given directly to the larvæ by the workers. A detailed description of the organ and of its extraordinary variations of structure in the various genera of Formicidæ is reserved for future publication.

In its development the trophorhinium bears a strange resemblance to the stridulatory organs of the petiole and postpetiole of many adult Ponerinæ and Myrmicinæ. It may, in fact, function also as a stridulatory organ, when the food supply is exhausted, and thus apprise the worker nurses of the larva's hunger. Many ant-larvæ, notably those of the Ectatommiine Ponerinæ and of most genera of Camponotinæ (Formicinæ), also have elaborate but coarser stridulatory surfaces on the mandibles, so that the larva

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may be able to produce a variety of sounds and therefore apprise the nurses of more than one need or craving.

The adult Pseudomyrminæ are so peculiar in structure that Emery, Ashmead (1905) and others have been led to separate them sharply from all other Myrmicinæ. The shape of the head in the worker and female and especially of the clypeus and frontal carinæ is unique, the eyes are very large and there is a strong tendency to development of ocelli in the workers, the conformation of the petiole, postpetiole and tibial spurs is peculiar, and as I have recently shown (1919b), the number of antennal joints (12) is the same in the male as in the worker and female in all four genera.

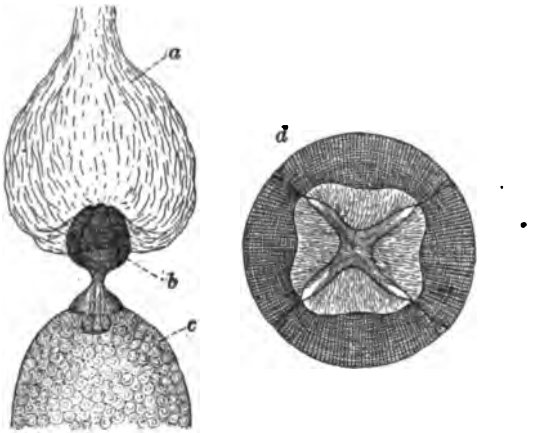

Fig. 1. *a*, Ingluvies, or "crop," *b*, calyx of proventriculus, or "gizzard," and *c*, ventriculus, or "stomach," of *Pachysima aethiops* Fabr.; *d*, proventriculus seen from the front under a higher magnification.

Little study has been devoted to the structure of the proventriculus, or "gizzard" in the Myrmicinæ, but Meinert, Forel and Emery have described and figured it as simple and tubular in most genera and of a very primitive type compared with the conditions in the Dolichoderinæ and Camponotinæ. I find, however, that the proventriculus of all four genera of the Pseudomyrminæ is much more specialized, being anteriorly developed as an apple- or quince-shaped ball, covered with longitudinal and circular muscles and with four distinct, connate sepals, bluntly rounded and finely hairy at their tips, and posteriorly as a very short, tubular, con-

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stricted portion which projects as a button into the cavity of the ventriculus (Figs. 1 and 2). The peculiarities mentioned seem to me to justify us in returning to Emery's contention of 1899 that the Pseudomyrminæ constitute an independent subfamily. I have endeavored to show in a recent paper (1919a) that neither the larval nor the imaginal Metaponini can be regarded as at all closely related to the Pseudomyrminæ. Emery's section Promyrmicinæ should therefore be abandoned and his term Eumyrmicinæ may be regarded as merely synonymous with Myrmicinæ.

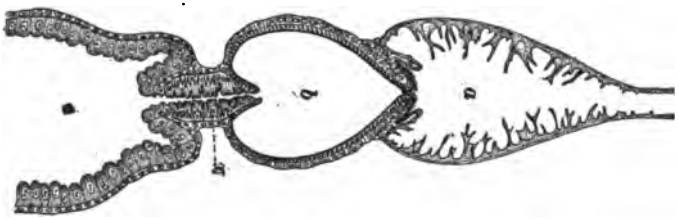

Fig. 2. *Viticicola tessmanni* Stitz; *a*, sagittal section through part of the alimentary tract, including *a*, the ingluvies, or "crop" (much contracted); *b*, calyx of proventriculus, or "gizzard," *x*, its cylindrical portion, and *c*, anterior portion of ventriculus, or "stomach."

A study of the larvæ of the Cerapachyini shows that they are extremely like the larvæ of the Dorylinæ. This was noticed by Emery in his observations on the larva of *Acanthostichus serratulus* (1899). The mandibles are small, narrow, pointed and rather feebly chitinized, and I have failed to find a trophorhinium in either group. Apparently the young are fed only on soft food. That the foraging habits of certain Cerapachyini (*Phyracaces*) resemble those of the Dorylinæ was shown in my paper on the Australian species (1918a). We know nothing of the pupæ, but they are probably not enclosed in cocoons as in the Ponerinæ. Although the worker of the Cerapachyini has a Ponerine habitus, the characters of the female in the various genera are peculiarly diverse. In some cases (*Phyracaces*), this caste is winged and not unlike the females of certain Ponerinæ, in others (*Parasyscia*, *Eusphinctus*) the female is wingless and ergatomorphic and in still others (*Acanthostichus*, *Nothosphinctus*) the female is so much like the corresponding caste in the Dorylinæ, that it might be regarded

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as a dichthadiigyne. A similar diversity is seen in the males of the Cerapachyini. The male of *Acanthostichus afflictus*, recently discovered by Gallardo (1919) in Argentina, is so much like an *Eciton* or *Dorylus* male that even an expert myrmecologist would not hesitate to place it among the Dorylinæ. The males of other genera (*Lioponera*, *Phyracaces*, *Cerapachys*, *Eusphinctus*) on the other hand, though lacking the cerci, have a decidedly Ponerine habitus. It would seem, therefore, that the Cerapachyini are intermediate between the Dorylinæ and Ponerinæ, as Emery has contended, and that we might unite them with either. I should prefer, however, to separate them out as an independent subfamily, which may be ascribed to Forel, who in 1893 first recognized the "Cerapachysii" as a natural tribe. Of course, the name Prodorylinæ Emery cannot be used for the subfamily, because there is no genus *Prodorylus*.

For many years I have deemed it necessary to introduce another nomenclatorial change, namely that of the subfamily name Camponotinæ to Formicinæ. Forel, in his study of the poison apparatus and anal glands of ants, published in 1878, divided the subfamily Formicidæ Mayr (1855) into two subfamilies, which he called Camponotidæ and Dolichoderidæ. This was unjustifiable according to our present rules of nomenclature, for Mayr's name should have been retained and restricted to the group containing the genus *Formica*. At that time, which antedated the use of *inæ* as a subfamily suffix, Forel justified his course on the ground that "Formicidæ" was already in use as a family name.

Owing to the fact that definite rules and conventions in regard to the suffixes of family and especially of subfamily names in Zoölogy have been stabilized only within recent decades, there is considerable confusion concerning the authors to whom our modern names in *idæ* and *inæ* are to be attributed. It seems to be customary to accredit a family or subfamily name to the author who first recognized the group as supergeneric and gave it a Latin or Greek name based on that of one of its genera. If this is done in the case of the Formicidæ the authorities cited in the literature require revision. Frederick Smith (1851), Westwood (1840), Shuckard (1840) and Stephens (1829) all attribute Formicidæ as a family name to Leach. They appear to refer to his article published in the Edinburgh Encyclopædia in 1815, where he used the term

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Formicarides, or to some later work which I have not seen. Latreille, however, as early as 1810, used Formicarii as a family name, and it would seem to be permissible to cite him as the author of Formicidæ. The subfamily Dorylinæ is attributed by Emery and others to Shuckard (1840), but this author says: "Mr. Haliday has first raised them to a family equivalent to the whole of the social Ants, etc." and at p. 195 he definitively attributes the Dorylidæ to Haliday. This may have been based on correspondence as I find no mention of the term in such published writings of Haliday as I have seen. But the matter is of little moment because Leach, in the 1815 paper referred to above, created a family Dorylida, so that, unless there is an earlier authority, the subfamily Dorylinæ should be accredited to this early British entomologist. Forel attributes the subfamilies Ponerinæ and Myrmicinæ to Lepeletier, but Dalla Torre gives Mayr as the author of the latter and Donisthorpe refers the Ponerinæ also to Mayr. Smith regarded himself as the authority for Poneridæ and Myrmi-

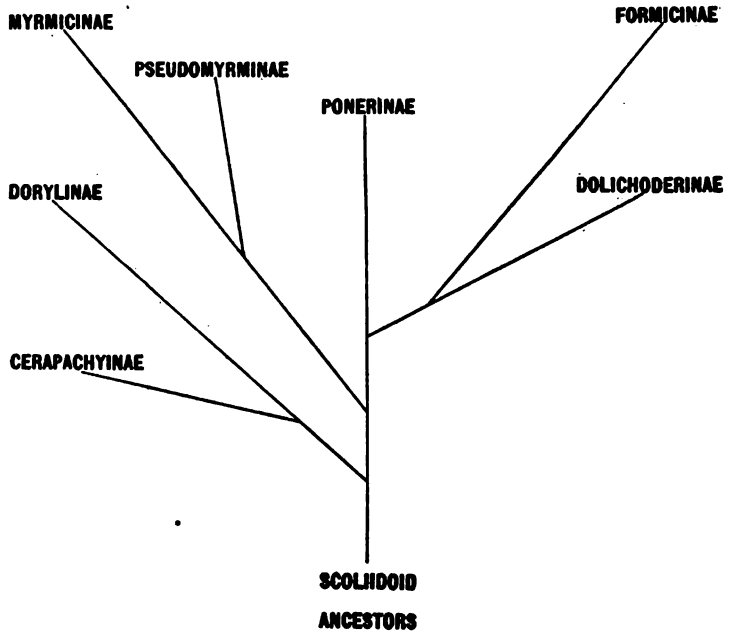

Fig. 3. Phylogenetic relationships of the seven subfamilies of Formicidae.

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cidæ. It is clear, nevertheless, that not only the Ponerinæ and Myrmicinæ but also the Formicinæ are to be referred to Lepeletier (1836), who called them respectively the tribes Ponérites, Myrmicites and Formicites, the last, like Mayr's subfamily Formicidæ, being made to include both the modern Dolichoderinæ Forel and Formicinæ (Camponotinæ Forel).

The phylogenetic relations of the seven subfamilies, as understood at the present time, are indicated in the accompanying diagram (Fig. 3). For taxonomic purposes they may be most conveniently arranged in the following linear sequence:

Family Formicidæ Latreille (1910).

Subfamily 1. Dorylinæ (Leach 1815)
2. Cerapachyinæ (Forel 1893)
3. Ponerinæ (Lepeletier 1836)
4. Pseudomyrminæ (Emery 1899)
5. Myrmicinæ (Lepeletier 1836)
6. Dolichoderinæ (Forel 1878)
7. Formicinæ (Lepeletier 1836)

In conclusion I may add that while working on the ants of the Belgian Congo and constructing dichotomic keys for the identification of the genera and subgenera of the world, I have been led to adopt the following new names based on previously described species:

Phrynoponera gen. nov. (Genotype: *Bothroponera gabonensis* Ern. André)

Viticicola gen. nov. (Genotype: *Sima tessmanni* Stitz)

Macromischoides gen. nov. (Genotype: *Macromischa aculeata* Mayr)

Hypocryptocerus subgen. nov. (Subgenotype: *Formica hæmorrhoidalis* Latreille)

Heteromyrmex gen. nov. (Genotype: *Vollenhovia rufiventris* Forel.)

Diodontolepis gen. nov. (Genotype: *Melophorus spinisquamis* Ern. André)

Pseudaphomomyrmex gen. nov. (Genotype: *Aphomomyrmex emeryi* Ashmead)

Cladomyrma gen. nov. (Genotype: *Aphomomyrmex hewitti* Wheeler).

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ODONATA OF CHATHAM, MASSACHUSETTS.

By R. Heber Howe, Jr.,
Thoreau Museum of Natural History, Concord, Mass.

The following list of Odonata includes material collected last summer at Chatham, and also that taken on various excursions to the surrounding towns. Mr. C. W. Johnson had collected a few species at Eastham of which I make mention, and other species have been recorded from Provincetown, Cotuit, Hyannisport, Woods Hole, Martha's Vineyard, the Elizabeth Islands, beside those listed by the author from Nantucket (May, 1919, report Maria Mitchell Association), and from Wareham (Psyche 26: June, 1919). Specimens of all recorded material are in the author's collection.

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Zygoptera.

Agrionidæ.

1. *Agrion maculatum* Beauv. One at Chatham, July 3. Not recorded from east of Wareham before.

Cœnagrionidæ.

2. *Lestes forcipatus* Ramb. Chatham, July 20 to Aug. 23. New to Cape Cod, east of Woods Hole.
3. *Lestes unguiculatus* Hagen. Chatham, Orleans, July 4 to Sept. 8. Common on Cape Cod.
4. *Lestes rectangularis* Say. Chatham, July 3–4. Common on Cape Cod.
5. *Lestes vigilax* Hagen. Chatham, South Yarmouth, Brewster, South Orleans, Eastham, July 8 to Sept. 6. Common.
6. *Argia violacea* (Hagen). Orleans, Aug. 23. Not recorded from east of Wareham before.
7. *Enallagma civile* (Hagen). Chatham, South Orleans, July 4 to Sept. 6. Abundant on Cape Cod.
8. *Enallagma durum* (Hagen). South Orleans, Portanimicutt Pond, July 27. Recorded before from Woods Hole, Cuttyhunk Island, Wareham and Nantucket.
9. *Enallagma minusculum* Morse. South Orleans, Orleans, Eastham, July 8 to 12. Mr. Johnson had taken this species at Eastham in June, 1904. Since the species was described in 1895 by Dr. Morse from Sherborn, Mass., its range has been extended to Meredith Neck, Lake Winnepesaukee, by the author in 1916; to Eastham and Manomet, Mass., by Mr. Johnson in 1904 and 1905; Mt. Desert, Echo Lake, Maine by Mr. Johnson in 1918, where it was again taken by Mr. D. Merrill in 1919. Until this summer no female had ever been captured. In sweeping the marginal grass swale along the pond I captured one female which may be described as follows: Cuneiform bluish post ocular spots not completely connected. Vertex, a mid-dorsal thoracic, and a humeral stripe iridescent black, rest of thorax bluish. Abdomen bluish with dorsum of segments 1 to 10 with a broad iridescent black stripe widening into distal semi-rings on segments 1 to 7. Legs black above. Lgth. 29 mm. Abd. 20 mm. Hd. Wg. 16 mm.

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10. *Enallagma signatum* (Hagen). Chatham, July 20. Not recorded from east of Wareham and Woods Hole before.
11. *Enallagma doubledayi* Selys. South Orleans, July 8 to Aug. 23. It has been reported from Provincetown by Mr. E. B. Williamson, and from Woods Hole, Nonamesset Island, by Dr. P. P. Calvert.
12. *Nehalennia irene* (Hagen). Chatham, Provincetown, July 12. Not recorded from east of Cotuit before.
13. *Ischnura posita* (Hagen). Chatham, Wellfleet, Barnstable, July 4 to July 22. Not recorded from east of Woods Hole before.
14. *Ischnura verticalis* (Say). Chatham, Eastham, Wellfleet, South Orleans, Brewster, Barnstable, South Yarmouth, July 8 to Sept. 8. Abundant on Cape Cod.

Anisoptera.

Æschnidæ.

15. *Progomphus obscurus* Ramb. South Orleans, July 12–14. Recorded only from Boston and Wareham before, this being the third station for New England.
16. *Anax junius* (Drury). Orleans, South Orleans, Chatham, July 3 to Sept. 6. Great migrating swarms of this species were noted at Chathamport. An abundant Cape Cod species.
17. *Æshna umbrosa* Walk. Orleans, Chatham, Oct. 19. Not recorded before from east of Wareham and Woods Hole on Cape Cod.
18. *Æshna clepsydra* Say. Chatham, July 11 to Aug. 23. Common on Cape Cod.
19. *Æshna canadensis* Walk. Chatham, Aug. 23. Not taken from east of Wareham and Woods Hole before on Cape Cod.

Libellulidæ.

20. *Epicordulia princeps* (Hagen). Chatham, White pond, July 24. Not recorded before from east of Wareham on Cape Cod.
21. *Tetragoneuria cynosura* (Say). Orleans, July 1-3. Not recorded from east of Wareham or Woods Hole before.
22. *Libellula exusta* (Say). Chatham, July 7. Not recorded before from east of West Chop and Woods Hole.

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23. *Libellula pulchella* Drury. Chatham, Orleans, Brewster, July 1 to Aug. 23. Common on Cape Cod.
24. *Libellula semifasciata* Burn. Chatham, Orleans?, July 3–7. Recorded before from several stations on Cape Cod.
25. *Libellula incesta* Hagen. South Orleans, July 27. Not recorded before from east of Wareham and Woods Hole on Cape Cod.
26. *Libellula auripennis* Burn. South Orleans, July 27. Rare. Common about Buzzard's Bay.
27. *Platyemis lydia* (Drury). Chatham, July 17. Not recorded before from east of Wareham and Woods Hole on Cape Cod.
28. *Perithemis domitia* var. *tenera* (Say). South Orleans, July 27 to Aug. 23. Not recorded before from east of Wareham and Woods Hole on Cape Cod.
29. *Nannothemis bella* (Uhler). Brewster, July 12. Not recorded before from east of Wareham on Cape Cod.
30. *Erythrodiplax berenice* (Drury). Chatham, Cotuit, Orleans, July 20 to 27. Common at littoral stations where salt marshes are present.
31. *Pachydiplax longipennis* Burn. Orleans, July 3 to Aug. 23. Common on Cape Cod.
32. *Sympetrum rubicundulum* (Say). Chatham, Barnstable, July 3 to Sept. 6. Abundant on Cape Cod.
33. *Sympetrum vicinum* (Hagen). Chatham, Aug. 23 to Oct. 20. Common on Cape Cod.
34. *Leucorrhinia intacta* Hagen. Chatham, July 3 to 20. Common on Cape Cod.
35. *Celithemis elisa* (Hagen). Brewster, South Orleans, South Yarmouth, July 8 to Aug. 23. Common on Cape Cod, and with the small middle wing spot commonly absent.
36. *Celithemis ornata* (Ramb.). South Orleans, Quanset pond, July 27. Not uncommon on Cape Cod.
37. *Tramea carolina* (Linn.). Chatham, July 3 to Sept. 8. Not recorded before from east of Wareham and Woods Hole on Cape Cod.

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THE BRACONID GENUS TRACHYPETUS GUÉRIN.

By Charles T. Brues,
Bussey Institution, Harvard University.

In 1839 Guérin[1] published an account of a very strange Australian Braconid for which he erected the genus Trachypetus. He placed Trachypetus in proximity to Helcon, Sigalphus and Chelonus and recent authors (*e. g.* Ashmead and Szépligeti) have tabulated it as a member of the Cheloninæ, next to Sphæropyx. Apparently this insect remained unknown in nature to hymenopterists since Guérin's time, until 1911 when Schulz[2] examined two specimens in the Saussure collection, obtained in New South Wales. Schulz (*loc. cit.*) makes Trachypetus the type of a new subfamily Trachypetinæ which he places provisionally in the "Cryptogastrini." Among these, he would distinguish the Trachypetinæ by the petiolate abdomen in which the first segment is articulated to and not fused with the post-abdomen as is the case in the other Cryptogastrini except Sphæropyx.[3]

Last summer, I received from Dr. R. J. Tillyard, two specimens of a magnificent Braconid collected at Woy Woy, Queensland, which Dr. Tillyard was unable to place satisfactorily in any family. These prove to be Guérin's *Trachypetus clavatus* which is very carefully described at considerable length in the first publication cited above, and in still greater detail by Schulz.

Trachypetus is undoubtedly a Braconid, but it is much more difficult to locate it in any of the recognized subfamilies. Superficially it is somewhat similar to Sphæropyx in the form of the abdomen which, however, lacks the deeply concave venter characteristic of the Cheloninæ. The wings, aside from the radial cell, and the neuration of the hind pair, are somewhat like those of Sphæropyx as are also the form of the propodeum, multiarticulate antennæ and the legs; here, however, the similarities cease. There

[1] Voyage de la Coquille, Zoöl., vol. 2, pt. 2, p. 201; atlas, pl. 8, fig. 7.

[2] Zoöl. Ann., vol. 4, p. 85.

[3] Sphæropyx includes one well known and widespread European species, *S. irrorator* Fabr. and several North American species described by Provancher and Cresson. Whether all these may be considered as congeneric, I do not know, but Cresson's species, *S. bicolor* is quite similar to *S. irrorator* and could scarcely be separated although much smaller and of somewhat different habitus. I do not know Tetrasphæropyx Ashmead which is based on *Rhogas pilosus* Cresson, but Mr. Rohwer has kindly examined Ashmead's type and writes me that it is a Rhogadine.

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is no circular mouth-opening, which at once removes Trachypetus from the several subfamilies of the group Cyclostomi, with none of which it has otherwise any characters in common, except perhaps the fact that the abdomen resembles slightly that of some

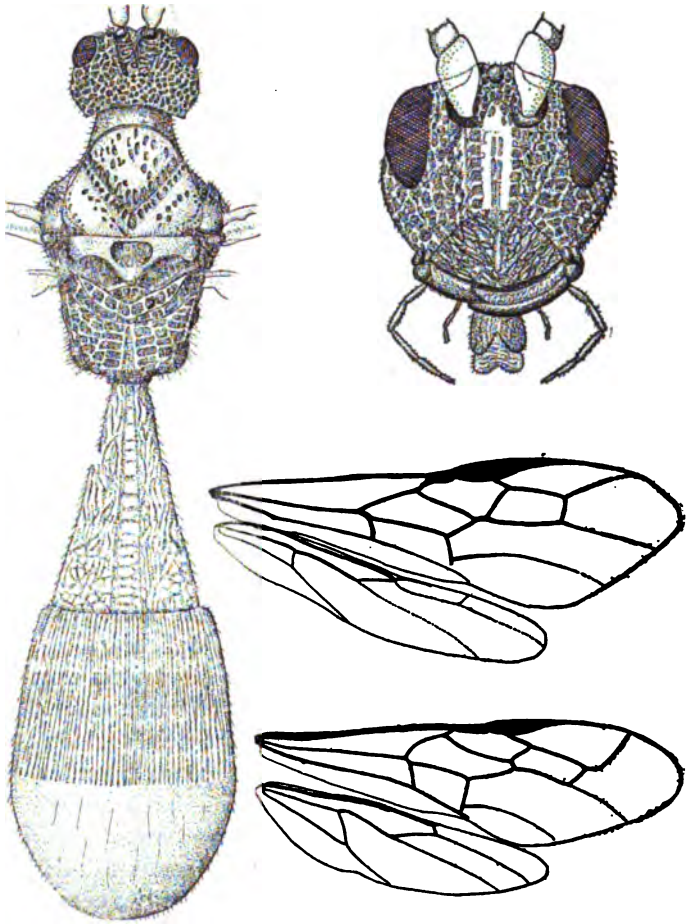

Fig. 1. *Trachypetus clavatus* Guérin; body from above and head from the front; wing of Sphæropyx above, of Trachypetus below.

Stephaniscinæ. It could not possibly be placed in this group and must fall in the Polymorphi, with several groups of which it appears to be allied, although not easily referable to any one of them.

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As it has been placed in the Cheloninæ, I shall first compare it with the members of this subfamily. Of these only Sphæropyx has the abdomen petiolate with an actually flexible articulation between the petiole and the post-abdomen. In that genus the carapace is divided by a deep, crenulate suturiform articulation, so that so far as the abdomen is concerned Sphæropyx is more like a Braconine than Chelonine if we take Chelonus, Ascogaster, or even Phanerotoma as typical of this subfamily. In neuration, except for the truncate radial cell, Trachypetus is rather similar to Sphæropyx, neither of which closely resembles any Chelonine. Indeed the neuration of certain Sigalphinæ is more like that of these two genera except for the presence of only two cubital cells and a less complete venation in the hind wing. Beyond the petiole the abdomen of Trachypetus is practically unsegmented although there is a trace of the suturiform articulation, a condition met with occasionally in groups other than the Cheloninæ and Sigalphinæ.

As to its relation to other groups of the Polymorphi, Trachypetus appears to be very generalized. The abdomen is clearly petiolate as in the Meteorinæ and Euphorinæ and Helorimorphinæ with which it clearly has no close affiinity. There are three cubital cells and a large, complete radial cell as in the Macrocentrini and Helconinæ, to which latter group it shows, I think, the closest affinities. Several genera of Helconinæ with the abdomen clavate have been described, such as Brulléia Szép. from New Guinea, and Euscelinus Westw. from Borneo, while Hymenochaonia D. T. (*Chaonia* Cress.) from Cuba may possibly belong here. None of these, however, have the segments of the post-abdomen so completely fused and all may be quite different from Trachypetus, as I unfortunately do not know them in nature. Sphæropyx lacks the thick Helconine head, which is present in Trachypetus.

Aside from the closed marginal cell, the neuration is quite like that of Cardiochiles Nees. as is also the structure of the head, thorax and legs.

Even outside the family Braconidæ, the fusion of the abdominal tergites into a carapace or shield-like piece occurs and this character alone is in no way distinctive of the Cheloninæ. Thus in the Alysiidæ, Symphya has a typical carapace and even in Vanhornia, the type of quite a different family with exodont mandibles the upper surface of the abdomen forms a carapace.

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From the foregoing it would appear that Trachypetus is a very generalized Braconid, perhaps best placed in the subfamily Helconinæ as at present understood unless it be separated as Schulz has done as a monotypical subfamily known only by one species in one sex, a position of very doubtful stability. As I believe that the present unsatisfactory classification of the Braconidæ as a whole can be improved only by a careful examination of the quite considerable number of apparently aberrant forms, I have taken this occasion to discuss and figure Trachypetus.

AN INFESTATION OF THE WHITE-PINE APHID.

By H. B. Peirson,
Bussey Institution, Harvard University.

While working at the Harvard Forest, Petersham, Mass., my attention was called to a somewhat isolated clump of white-pine trees, forty to fifty years old, which were dying. The trees averaged about fourteen inches D. B. H. and were approximately twelve in number. On two sides of the clump of mature trees were young white-pine plantations. A careful examination showed that the trees were being killed due to an extremely heavy infestation of black aphids which upon identification proved to be *Lachnus strobi* Fitch., the White-pine Aphid. Many of the larger limbs were barren of foliage, whereas on others the foliage was brown, the individual needles each showing many puncture marks where the aphids had been feeding.

The trees were first examined October 10, 1919, at which time the aphids were laying their eggs on the needles. These are laid end to end generally in lines of five or six, although as many as twenty-seven were found on a single needle, and it was not at all uncommon to find as many as ten or fifteen attached end to end. The eggs were invariably laid on the green needles, and the aphids apparently anticipating the death of the older trees were laying the majority of the eggs on the younger trees in one of the adjacent plantations. Practically all of the needles on the more heavily infested trees had batches of eggs on them.

Large numbers of the aphids were still feeding. These had congregated on the needles and small twigs. The survival of the

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aphids in spite of heavy rains and low temperatures was remarkable, subsequent examinations showed them feeding up until about the first of November. Very few winged individuals were found. The oviparous females are brownish black in color, with a white line along the middle of the thorax. The antennæ are pale, with black tips.

The eggs are smooth and elongate, averaging .12 mm. in length by .02 mm. in breadth. They are of a pale yellow tinge when first laid, but in a few hours the color changes to a dark orange, and later to a shiny jet black.

TWO NEW SCHENDYLOID CHILOPODS FROM GUATEMALA.

By Ralph V. Chamberlin,
Museum of Comparative Zoölogy, Cambridge, Mass.

The interesting new chilopods described below are represented by single specimens taken from soil about the roots of the pacaya or salad palm (Chamædorea sp.) from Coban, Guatemala, at quarantine in Washington, D. C., January 29, 1920, by Messrs. W. B. Wood and H. L. Sanford and transmitted to me for identification from the United States Bureau of Entomology. In addition to the two chilopods, two diplopods were also found, these being *Orthomorpha coarctata* (Saussure) and Cleidogona sp., the latter being represented by an immature specimen which is possibly *C. stolli* Pocock.

Sogolabis gen. nov.

Labrum not free, forming an arc armed with an even series of teeth much as in, *e. g.*, Adenoschendyla.

Claw of palpi of second maxillæ long, the margins smooth, neither pectinate or spined. Pleurosternal suture of second maxillæ complete, sharply marked, the pleurite extending forward to coxosternum.

No ventral pores present.

Coxopleural pores of pregenital segment small, simple, several on each side as in Escaryus.

Anal legs composed of six articles beyond coxopleura, without claw.

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Genotype: *S. scapheus*, sp. nov.

A genus differing from all other schendylids excepting Escaryus and Eucratonyx in having several coxopleural pores on each side. From these genera it differs in not having the labrum free, in the non-pectinate claw of the second maxillæ, the absence of chitinous lines from the prosternum, etc. It departs from all other known schendylids in having the anterior margin of the prosternum and the femuroid of prehensors armed.

Sogolabis scapheus sp. nov.

Pale fulvous, with the head and prehensorial segment orange.

Head longer than wide in about ratio 13:8. Sides of head nearly parallel from the oblique caudal corners forward to in front of the middle, then slightly converging. Anterior margin convex, not notched at middle. Posterior margin truncate. No frontal suture.

Antennæ filiform, the last joint about equalling the two preceding taken together.

Prebasal plate not exposed. Exposed portion of basal plate short, broad. Claws of prehensors when closed surpassing the head, attaining the distal end of the first article of the antennæ. Anterior margin of prosternum armed with two strongly chitinized teeth which in the type are broader than high, rounded. Femuroid of prehensors armed toward distal end with a subconic but distally rounded tooth of moderate size. Next two joints unarmed. Claw armed at base with a larger, strongly chitinous, tooth which is conical, distally acute.

First legs a little shorter and more slender than the second, the others nearly uniform in length and thickness to the penult inclusive.

No ventral pores detected in the type.

Sternite of pregenital segment of moderate width, nearly equal in width and length, trapeziform, the sides and posterior margin straight. Each coxopleura with five simple pores.

Last legs longer than the penult; with few hairs; last article clawless, distally rounded.

Anal pores present.

Number of pairs of legs in female, thirty-nine.

Length, 8 mm.

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Schendylellus gen. nov.

Median arc of labrum armed with strongly chitinous true teeth with distinct roots.

Claw of palpi of second maxillæ abortive, in the genotype appearing only as an extremely minute rudiment or point.

Ventral pores present on sternites, these arranged in a narrow transverse band across plate at level of major setæ.

Coxopleuræ of pregenital segment each with two homogeneous glands.

Genotype,—*S. hodites*, sp. nov.

This genus is obviously close to Schendyla, but differs in the abortive claw of the palpi of the second maxillæ and in the arrangement of the ventral pores, these in Schendyla forming a median area as long as or longer than wide and commonly quadrate or sub-circular in outline.

Schendylellus hodites sp. nov.

General color pale fulvous, head and prehensors dilute orange.

Head widest toward posterior end, narrowing forward, the anterior and posterior margins truncate. Prebasal plate not exposed.

Antennæ filiform, the last four articles preceding the ultimate in the type much shortened, the last three of these about equalling the ultimate in length.

Median arc of labrum with ten, not crowded, teeth, or near that number.

Claws of prehensors when closed a little surpassing the anterior margin of head but not attaining the distal end of first antennal article. Prehensors in dorsal view also a little exposed toward base. Claw armed at base with a very small but distinct tooth, the other joints unarmed. Anterior margin of prosternum unarmed, smooth.

First legs a little shorter and more slender than the second, the others of nearly uniform length and thickness to the penult inclusive.

Ventral pores beginning on the first sternite and present on all to the thirty-fourth segment, *i. e.*, to the penult pediferous. On the first plate they are few, only about six in number, these being in an irregular transverse row at middle of plate. On the succeeding sternites the pores are more numerous and form a narrow transverse band extending on each side well toward the lateral margin

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at level of posterior major marginal seta. Pores fewer again on the last several plates.

Sternite of pregenital segment broad, trapeziform. Coxopleural glands two on each side, simple, the pores covered by the sternite.

Last legs in the male clavately enlarged, scarcely exceeding the penult in length. Unfortunately these became detached and lost in the course of the clearing of the specimen for mounting for microscopical study.

Number of pairs of legs in the male, thirty-five.

Length of the type, 7.5 mm.

It is thought best not completely to dissect the head of the single type specimen at this time. Hence mandibles and maxillæ are not described in detail.

PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB.

At the meeting of the Cambridge Entomological Club February 10, on account of the difficulties of travel only 14 persons attended. The meeting voted to approve the publication, in PSYCHE, of abstracts of the proceedings of the Club meetings and of local entomological news.

Prof. C. T. Brues read some notes on distribution of South African Hymenoptera, several of which occur or have their nearest relatives in South America or India rather than in more northern parts of Africa. Professor Wheeler read a satire on human society from the supposed standpoint of a member of a colony of Termites. This paper is published in the *Scientific Monthly* of February, 1920.

Mr. Varás showed a beetle with a branched tibia of one of the third pair of legs, and this was followed by discussion of abnormal insert legs in general.

At the meeting of March 9, Mr. J. H. Emerton read some notes on last season's collections of spiders in Canada, including specimens from the Rocky Mountains, near Banff, Pribiloff Islands, Klondike Valley, Gaspe, St. John's, Newfoundland, Ontario and Quebec.

Mr. Frost read notes on the habits, occurrence and classification of several Coleoptera which he had found in Maine—*Scythropus elegans*, *cicendela elegans* and *cicendela spreta* Lecr. The latter species he thought to be the same as *C. limbalis* Klug.

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Wanted: Syrphidæ (Flower-flies) from all parts of the world. Exchanges solicited. Will determine on the usual conditions.—C. L. Metcalf, Ohio State University, Columbus, Ohio.

Largest Expanse—one each ♂ and ♀ Lepidoptera wanted for transfer purposes. Those not good enough for collections will do. Will buy, or exchange for local Lepidoptera, etc.—C. V. Blackburn, 12 Pine St., Stoneham, Mass.

Butterflies of Japan and Formosa, will be exchanged by S. Satake, 48 Aoyamaminamimachi 5-chome, Tokyo, Japan.

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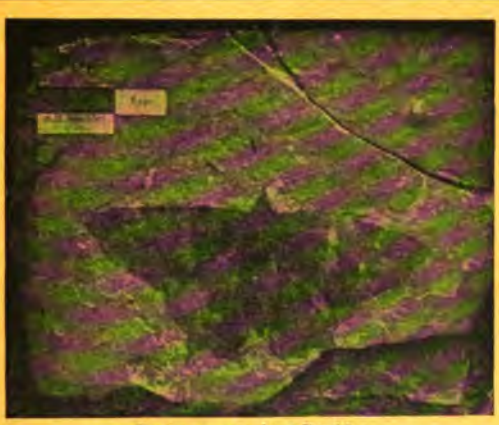

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PSYCHE

VOL. XXVII OCTOBER, 1920 No. 5

SYNOPSIS OF THE DIPTEROUS FAMILY PSILIDÆ.[1]

By A. L. Melander,
Pullman, Washington.

The following keys are given to assist in the determination of the flies of the family Psilidæ as at present known from North America. The study is based entirely on my own collection, species before me being indicated by starring the localities represented. In the February (1920) issue of Psyche Mr. Charles W. Johnson gives tables of *Loxocera* and a new genus, *Pseudopsila*. With slight modifications these tables are incorporated in the present paper.

Table of Genera.

1. Antennæ greatly lengthened, longer than the head, the third joint very slender, more than four times the length of the second joint and distinctly longer than the arista; no fronto-orbital or postvertical bristles...*Loxocera* Meigen
   Antennæ shorter, the arista longer than the third joint 2
2. Third antennal joint subcylindrical, about three times as long as the second; no fronto-orbitals, but postverticals present, one presutural dorsocentral present ...*Pseudopsila* Johnson
   Third antennal joint short, ovate, rounded.....3
3. Face very strongly retreating; anal cell as long as second basal.....*Psila* Meigen
   Face more nearly perpendicular, the head not triangular in profile 4
4. Robust; occiput flat, ocellar triangle small and placed well back; 4 scutellar bristles; pteropleuræ bare; first vein ending opposite anterior crossvein, second vein near wing-tip, anal cell shorter than second basal and truncate *Chyliza* Fallen
   Slender; head spherical, ocellar triangle placed forward; 2 scutellar bristles; pteropleuræ with hairs; first vein ending before anterior crossvein, second vein about midway

[1] Contribution from the Zoölogy Laboratory of the State College of Washington.

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between posterior crossvein and wing-tip, anal cell almost equalling second basal and with rounded apex
Strongylophthalmyia Heller

Loxocera Meigen

Eyes large, in profile attaining the front margin of the head, with the occiput one-tenth and the cheeks one-third their greatest diameter 2
Eyes small, nearly round, not reaching the front of the head, the occiput one-third and the cheeks fully as wide as their greatest diameter. (Wash.*) ..... *microps*, sp. nov.
2. Wings hyaline with the tip and posterior crossvein clouded. (*cylindrica* Say) 3
Wings uniformly brownish hyaline 4
3. Anterior margin of the thorax, a dorsal line, humeri, and lateral lines, black. (N. H., Vt., Mass., Pa., Ill.,* Minn., Kans.)
var. *cylindrica* Say
Anterior margin very broad, covering at least one-third of the thorax, a dorsal line, short lateral lines and about one-third of the anterior of the pleura, black. (Me., N. H., Vt., Quebec,* Mass.,* Conn., N. Y.,* N. J., Mich., Kans.)
var. *pleuritica* Loew
Dorsal line, humeri, lateral margins and the upper half of the pleura, black (N. H., Vt., Mass., Pa., D. C., Va.)
var. *pectoralis* Loew
Dorsal and lateral lines (sometimes obsolete) and a spot above the yellow humeri, black. (Vt., Mass., Conn., N. J., Pa., D. C.,* Va., N. C., La.,* Tex.*) ... var. *obsoleta* Johnson
4. Anterior third of the thorax black, dorsal and lateral lines wanting; abdomen, except the sides of the first segment, black. (Me., Mass.,* Conn., N. H., N. J., Va., Wis., Mont.,* Idaho,* Wash., Ore.) ..... *collaris* Loew
Anterior and lateral margins and a dorsal line on the thorax, black; abdomen except at the base red. (Kans., Tex., Colo.*) ..... *fumipennis* Coquillett

Loxocera microps sp. nov.

Male. Length, 5 mm. Polished testaceous variegated with black. Head testaceous with a median frontal black stripe, ante-

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rior orbits blackish; frontal triangle attaining suture and occupying half of the front at the ocelli; face greatly receding, antennal grooves white-velvety, center stripe wide and polished; eyes small, nearly round, not reaching front margin of profile by one-fifth their greatest diameter and the hind margin by about one-third, facets uniform, cheeks deeper than eye, orbits distinctly sunken; occiput flat, swollen in back of the cheeks, with fine yellow hairs; palpi tipped with brown; antennæ greatly lengthened, basal joints small, third joint twenty times as long as the second, arista yellow, the thickened basal part with brown tip, pubescence microscopic. Thorax testaceous, notum centrally broadly black in front, vestiture pale yellow, bristles weak and black, one dorsocentral and one pair scutellars; metanotum centrally blackened; mesopleuræ with white hairs below. Abdomen piceous, sides toward the base yellowish; genitalia minute. Legs yellowish. Halteres pale yellow. Wings nearly hyaline with a brownish tinge, veins firm and brown, sections of fourth vein proportioned 2: 5: 4, third and fourth veins apically parallel.

Two specimens. Paradise Valley, Mount Rainier, Wash., August, 1917.

Pseudopsila Johnson.

Thorax entirely black (N. H., Mass., N. Y., Can.)...*fallax* Loew
Thorax yellow, marked with black.....2
2. Dorsum without lateral margins of black.....3
Dorsum with lateral margins of black.....4
3. Humeri and upper half of pleuræ black (Vt., N. Y.) (Proc. Acad. Nat. Sci. Phil., 1919, 193) (*Psila*)...*angustata* Cresson
Anterior margin, pleuræ, metanotum and a narrow dorsal line black. (Me., N. H.) (PSYCHE, 1920, 18)...*perpolita* Johnson
4. With broad lateral margins only, upper half of pleuræ black. (Conn., Me., N. J., Pa., Quebec) (*Psila*)...*bivittata* Loew
With a broad anterior and lateral margins, upper half of pleuræ black. (N. H., Mass., Conn., Va.) (*Psila*)...*collaris* Loew

Psila Meigen.

Mesonotum and pleuræ entirely yellow.....2
Thorax more or less black; abdomen wholly black.....5

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2. Entire insect yellow, except the black frontal or ocellar triangle; arista, and cephalic and thoracic bristles black.....3
Head and thorax yellow, abdomen wholly black; arista and bristles yellow, the arista short-pubescent; tip of palpi black (*bicolor* Meigen).....4
3. Frontal triangle large, black, polished; arista, pubescent; antennæ half as long as the face. (N. H.)
frontalis Coquillett
Only ocellar triangle black; arista bare; antennæ distinctly less than half the facial length. (Ore.)..*microcera*, sp. nov.
4. Metanotum wholly yellow (Europe, N. H., Can., Mont.,* Wyo.,* Wash., Alaska).....var. *bicolor* Meigen
Metanotum centrally black (Can., Colo.,* Wyo.)
var. *dimidiata* Loew
5. Mesonotum yellow the humeri alone black; only upper pleuræ black; bristles of head and thorax black; third antennal joint dark.....6
Mesonotum centrally black.....7
6. Head entirely yellow except the small ocellar spot; palpi yellow (Tex.*).....*colorata*, sp. nov.
Occiput bimaculate; palpi black (N. J., D. C., Wis.)
lateralis Loew
7. Bristles of head and thorax black; legs mostly black; antennæ, the nearly bare arista, and the palpi black; head and sternopleuræ black.....8
Bristles of head and thorax yellowish; coxæ and legs yellow; arista yellowish; head yellowish.....9
8. Base of arista thick; last section of fourth vein arched and shorter than the penultimate section. (Wash.*)
washingtona sp. nov.
Arista not thickened; last two sections of fourth vein equal; face greatly receding; two dorsocentrals. (Idaho*)
atrata, sp. nov.
9. Sternopleuræ black; at least tip of palpi blackened; third antennal joint mostly or wholly yellow.....10
Sternopleurae black; palpi and antennæ yellow; mesonotum with short white pilosity (Mex.).....*exigua* Wulp
Sternopleuræ yellow; palpi wholly yellow; third antennal joint black. (N. Y.,* N. J.,* Ill.,* Wis.).....*sternalis* Loew

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10. Palpi wholly black; third antennal joint round, wholly yellow (eastern) or upper edge dark (western); frontal triangle black. (N. H., Alaska*)..... .....*levis* Loew
Palpi with black tip; third antennal joint oval, tipped with black; only ocellar spot black. (Europe*; Can., N. Y., Colo., Wash.*).....*rosæ* Fabricius

Psila microcera sp. nov.

Male. Length, 4 mm. Entirely yellow except for the black ocellar prominence and the black upper edge of the third antennal joint. Frontal triangle almost reaching the suture, periorbits distinct, one fronto-orbital, postverticals diverging and long, cephalic bristles black; antennæ short, third joint rounded, slightly longer than deep, arista bare and black. Eyes nearly round, equal to the longest diameter of the cheek. Thoracic bristles black, strong, two notopleural, one supra-alar, one dorsocentral, two scutellars. Wings hyaline, with a yellowish tinge, veins yellow, sections of the fourth vein proportioned 2 : 7 : 5, of the fifth vein 12 : 1, posterior crossvein transverse.

A single specimen collected by Professor A. L. Lovett at Duffy Prairie, Ore., July 26, 1915, and presented by F. R. Cole. Three females collected by R. C. Shannon at Sprague, Ewan and Medical Lake, Wash.* The last mentioned specimen has the bristles yellow.

Psila colorata sp. nov.

Male. Length, 4 mm. Head yellow, a small black spot between the ocelli; lower occiput swollen; third antennal joint twice as long as deep, black beyond the arista, which is yellow, and white-pilose; mouthparts yellow; cephalic bristles long and black, no fronto-orbitals. Mesonotum, scutellum, center of metanotum, and lower pleuræ yellow, humeri, mesopleuræ, pteropleuræ and sides of metanotum black, prothoracic spiracle yellow; thoracic bristles black, hairs yellow, one dorsocentral, pleural hairs sparse. Abdomen black. Legs wholly pale yellow, apical spurs small and yellow. Halteres whitish; calypteres luteous, the fringe blackish. Wings with yellow tinge becoming brownish apically, veins luteous, the third vein becoming brown, sections of fourth vein proportioned 1 : 1 : 2 : 2.1, the last section slightly arched, posterior

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crossvein transverse, curved, twice as long as the last section of the fifth vein.

One specimen. Austin, Tex., April 20, 1900.

Psila washingtona sp. nov.

Female. Length, 4 mm. Head, thorax and abdomen entirely shining jet black, the fine pubescence pale. Face one-third longer than the front; cephalic bristles black, two minute fronto-orbitals; antennæ black, the third joint bluntly triangular, one-half longer than wide, the arista black, thick at the base then subulate, its pubescence very short; mouthparts black. Thoracic bristles black, two dorsocentrals, pleural hairs not abundant. Legs mostly blackish, coxæ jet black, the knees, front tibiæ, tips of posterior tibiæ and the tarsi brown. Halteres yellow. Wings with uniform yellow tinge, veins yellow, sections of fourth vein proportioned 1 : 1 : 2 : 0.8, the last section arched, posterior crossvein nearly transversely located, more than twice as long as the last section of fifth vein.

One specimen. Mount Constitution, Orcas Island, Wash., July 17, 1909.

The species comes nearest the European *P. nigra* Fallen, which usually has from two to four dorsocentrals, one to three fronto-orbitals and the last section of the fifth vein more than half the length of the posterior crossvein; its arista is not thickened basally. *P. morio* Zetterstedt is also similar, but has two distinct fronto-orbitals, four dorsocentrals, black tarsi and the anterior crossvein more basally located. *P. atra* Meigen has a more pubescent arista, two fronto-orbitals and four dorsocentrals well developed.

Psila atrata sp. nov.

Length, 3 mm. Head, thorax and abdomen entirely shining black, the fine pubescence yellow. Head conical, the face very greatly receding and nearly half longer than the front; cephalic bristles black, one minute fronto-orbital; antennæ blackish, the third joint elliptical, the arista blackish, not greatly thickened at base, its brown pubescence short but obvious; mouthparts black. Thoracic bristles black, two dorsocentrals, pleural hairs sparse. Coxæ black, femora blackish, knees narrowly brown, anterior tibiæ and all tarsi brown, hind tibiæ broadly blackish along the

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middle. Halteres yellow. Wings with uniform slight yellow tinge, veins pale yellow, sections of fourth vein proportioned 1 : 1 : 2 : 2, the last section only slightly curved, posterior cross-vein nearly transverse, equal to the last section of fifth vein.

Twenty specimens. Type from Boville, Idaho, June 18, 1911; paratypes from same place (Melander), Troy (W. M. Mann) and Vollmer (J. M. Aldrich), all in Idaho; and Hood River, Ore. (F. R. Cole).

Chyliza Fallen

Dorsum of thorax yellow 2
Dorsum of thorax mostly black, the humeri and scutellum usually red 5

2. Pleuræ more or less yellow 3
   Pleuræ and pectus black, a quadrangular black prealar spot; abdomen black; all femora with apical black ring; palpi reddish (Mex.) ..... *enthea* Giglio-Tos
3. Pleuræ entirely yellow; wings hyaline (Fla.) ... *similis* Johnson
   Upper half of pleuræ with black vitta; apex of wings clouded 4
4. Apical cloud of wings following the margin, not widened behind, veins two, three and four ending in the cloud; pleuræ marked with only the vitta. (N. J., Pa., D. C., Kans.,* Colo., La., Mex.) (*Tetradiscus pictus* Bigot) . *apicalis* Loew
   Apical cloud widening behind, apex of veins two, three and four not clouded. (Mex.) (*Tetradiscus notatus* Bigot, not *Chyliza notata* Loew) ..... *bigoti*, nom. nov.
5. Front and hind femora blue-black but brownish at base, front tarsi black; palpi red; wings hyaline; thorax dark green, shining. (Can.) ..... *metallica* Walker
   Femora black except tips, tarsi yellow; palpi black; wings smoky; body black. (Ore.*) ..... *leguminicola* sp. nov.
   Femora largely yellowish, sometimes with subapical dark ring 6
6. At least hind femora with well marked subapical black or brown band; wings with apical clouding, second and third sections of costa as three to one 7
   Femora yellow, at most reddish apically; wings not clouded apically, second and third sections of costa of *robusta* proportioned two to one 11

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7. Femoral bands present on all legs; palpi brown (Europe; Mass., det. Hough) ..... *annulipes* Macquart
   Femoral bands weak or wanting on front and middle legs 8
8. Vertex narrower than depth of eye; head largely yellow, punctured; halteres yellow 9
   Vertex much broader than depth of eye; head black except narrow stripe on lower occipital orbits, deeply pitted; halteres black. (Wash.,* Ore.) ..... *scrobiculata* sp. nov.
9. Palpi entirely black 10
   Palpi tipped with black; anterior femora apically dark; sides of thorax more or less yellow; first posterior cell basally shaded. (Mex.) ..... *varipes* Wulp
10. Head, humeri, scutellum, posterior sides of mesonotum and at least sterno-mesopleural suture yellow. (N. H., D. C., N. J., Idaho.,* Wash.*) ..... *notata* Loew
    Thorax entirely black, except a reddish scutellar spot, occiput and frontal orbits mostly black. (Mass.*) .. *erudita* sp. nov.
11. Black; antennæ, broad apices of femora, tibiæ and scutellum reddish; marginal cell dark gray, costal cell brownish. (Nev.) ..... *robusta* Coquillett
    Blackish-green; antennæ black; legs yellowish; wings hyaline. ("U. S.") ..... *nigroviridis* Walker

Chyliza scrobiculata sp. nov.

Female. Length, 6 mm. Robust, deeply and closely punctured, with short dense woolly pale pubescence and short black bristles. Head large, eyes oblique, lower occiput deep, upper occiput flat, head coarsely punctured except the face and the shining vertical triangle which reaches half way to the antennæ, front opaque except the periorbital stripes; head black except for an orbital yellow stripe on lower occiput and a small orbital spot just below the antennal level; antennæ black above, yellow below, the third joint thumb-shaped, half longer than broad, arista brown on basal third, apically white; palpi broad, hairy and black. Thorax entirely black except the outer part of the scutellum, metathoracic callosities strong. Abdomen depressed, densely pubescent. Legs including the coxæ reddish yellow, the hind femora with a subapical incomplete black annulus. Halteres black. Wings smoky blackish throughout, darkest along the costa and at the tip, second

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costal section three times the third, first vein ending near middle of the wing, third and fourth veins parallel.

Two specimens. Spokane, Wash., 30 August (Melander); Whitman National Forest, Ore., July (W. J. Chamberlin) in the collection of F. R. Cole.

Chyliza leguminicola sp. nov.

Length, 4–7 mm. Black, the anterior part of the front, the immaculate face, cheeks, occipital orbits, antennæ and scutellar margin luteous, the extremities of the femora, the tibiæ except distal half of hind pair, and the tarsi flavous, coxæ fuscous, halteres whitish. Front square, eyes large, palpi broad, frontal bristles black and inconspicuous, arista piceous, cephalic pubescence yellow. Thorax with strong piligerous punctures, the yellow hairs more or less whorled, bristles black, reduced in size and number to one pair each of supra-alar, intra-alar, dorsocentral and acrostichal, four scutellars. Abdomen sericeous with golden pubescence. Calypteres and fringe yellow, wings infumated, darker anteriorly, veins firm and black, costal sections proportioned 4 : 5 : 2, fourth vein 1.5 : 2 : 3, fifth vein 10 : 1, hind crossvein transverse.

Three specimens sent by L. P. Rockwood, who has swept this fly from the lupine, *Lupinus polyphyllus* Lindl., at Forest Grove, Ore., toward the end of April. He has also found puparia attached to the lower part of this plant during July, from which adults emerged the following March when wintered at room temperatures.

Chyliza erudita sp. nov.

Male. Length, 5 mm. Black, closely but not deeply punctured, the pale pubescence dense and appressed, bristles black. Head variegated black and yellow, the occiput black except the lower orbits, front subshining, centrally brownish, measuring in width seven-eighths the depth of the eye, frontal triangle narrow, reaching two-thirds the length of the front, two fronto-orbitals, face yellow, with two blackish subantennal spots, cheeks black except at the mouth-opening, mouthparts black, the palpi very broad; antennæ yellow, the upper edge darker, arista white and feathery pubescent. Thorax entirely black except the reddish tip of the scutellum. Legs including the coxae pale yellow, the hind femora with prominent black subapical ring. Halteres pale yellow.

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Wings with costal half infumated, second and third sections of the costa proportioned 3 : 1, third and fourth veins parallel.

One specimen. Boston, Mass., May, 1914.

Strongylophthalmyia Heller

Heller, Wien. ent. Ztg. xxi, 226 (1902) *Strongylophthalmus* Hendel, Wien. ent. Ztg. xxi, 179–181 (1902).

One species occurs on the Pacific slope, having slender body and long legs suggestive of the Micropezidæ or the Cordyluridæ. The short antennæ and little receding face suggest *Chyliza*, but the slender, impunctate and nearly glabrous body and narrow wings are distinct from that genus. The vestigial, straight and evanescent auxiliary vein, distinct break in the costa before the end of the first vein, relatively long basal cells, absence of oral vibrissæ, slightly divergent postvertical bristles, pubescent arista, absence of distinct pleural bristles, and widely open first posterior cell indicate the family Psilidæ. From *Chyliza* the genus stands out in having the posterior cheeks not swollen, the center of the face neither sunken nor concave, the palpi slender, the pubescence of the notum and pleuræ not dense, appressed or parted in the female, the sides of the metathorax not calloused, the calypteres long-ciliate, the first vein shortened and the anal crossvein incurved. Hendel further characterized his genus as differing from *Chyliza* in having long ocellar and postvertical bristles, the latter located far behind the ocelli, mesopleuræ with distinct prealar bristle, only two strong scutellar bristles, with which chætotaxy the present species agrees. The pteropleural hairs are sparse.

Strongylophthalmyia angustipennis sp. nov.

Length, 3.5 to 5 mm. Head, thorax and abdomen polished black, impunctate, male with striking yellow pubescence, female with pubescence pale and sparse, bristles yellow. Head globose, the anterior part of the front, more extended in the male, the face, very narrow cheeks, and lower occipital orbits yellow, face short and narrow, half the length of the front; eyes large, lower facets larger than the upper ones; two fronto-orbital bristles, frontal triangle not polished; antennæ short, third joint orbicular, large and yellow in the male and brown and smaller in the female, arista brown, very briefly and closely pubescent; proboscis brownish,

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palpi narrow, yellow in the male and brown in the female. Thorax slender, pectus yellowish, pleuræ nearly glabrous. Abdomen narrow, male genitalia with two small spoon-shaped end-valves and central short penis, female abdomen tapering. Legs including coxæ pale yellow, the tarsi a little brownish, apex of hind femora and middle of hind tibiæ usually dusky. Halteres pale yellow, calypteres yellow, with long fringe. Wings narrow, three times as long as wide, hyaline, veins brown, first vein ending at basal third of the wing, second and third sections of the costa proportioned 2 : 1, sections of fourth vein nearly 1 : 2: 3, the last section arching forward but apically becoming parallel with the third vein, anal vein extending two-thirds the distance to the margin, anal crossvein recurved at tip.

Twelve specimens. Type from Potlatch, on Hood's Canal, Wash., July 28, 1917; others from Blaine, Lynden and Auburn, Wash., and Lake Coeur d'Alene, Idaho, July to September. Several of the specimens were found on windows.

ON CERTAIN SPECIES OF HALTICA, OLD AND NEW.

By H. C. Fall,
Tyngsboro, Mass.

About a year ago, after reading the then recently published paper[1] by William Colcord Woods on the life histories of certain Maine Halticas previously regarded as varieties of *H. ignita* Illig., and having examined typical examples of all forms, kindly sent by Mr. Woods, some observations seemed pertinent to the writer, but the matter was allowed to go by default, and nothing was done beyond communicating one or two points to Mr. Woods by letter, chief of which, perhaps, was the fact that his *Haltica torquata* was not the *torquata* of Le Conte.

More recently comes Mr. Malloch's article,[2] in which he, too, alludes to the probable error in identifying the eastern blueberry flea beetle as Le Conte's *torquata*. Although Mr. Leng frankly admits his responsibility for the mistaken identification, he is by no means the first offender, as the *torquata* mix-up really dates back to Horn's Synopsis of the Halticini in 1889, in which he erroneously

[1] Maine Agric. Exp. Station Bull., 273; October, 1918.
[2] Bull. Brooklyn Ent. Soc. XIV, p. 123.

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suppresses the name as a synonym of *carinata* Germ. As a matter of fact, in the series of *carinata* in the Horn collection the name label *is* attached to a specimen of *torquata* bearing the locality label "Bengtn Co., Vt." The type of *torquata* came from Santa Fé, New Mexico (not from Kansas as Malloch says), and while I have seen scores of specimens from New Mexico, Arizona, Nevada and California, I have as yet to see an example from anywhere east of the type locality. Mr. Malloch has specimens from western Kansas which he believes to be the true *torquata*. If he is correct in his identification, this must I think, be the eastern limit of its range; but I strongly suspect his specimens are representatives of an unnamed species which is associated with *torquata* in collections and which will be described in the present article.

The accuracy of the "Vt." label on the Horn specimen may, therefore, be most seriously questioned, the more so, since this is only one of a number of species ranging from the seashore to the western deserts, which bear the impossible label "Bengtn Co., Vt." These all come from the same collector, who undoubtedly mixed material from various sources, and then, perhaps long after, carelessly attached the same locality label to the whole bunch. It, therefore, behooves students of distribution to look with a very critical eye on this particular label before accepting it as genuine.

If, as all the available evidence seems to indicate, *torquata* does not occur east of the Rocky Mountains or vicinity, then it cannot be the *carinata* of Germar, which was described from Kentucky at so early a date that even accidental importation from the western plains or mountains is out of the question. Unfortunately Germar's description of *carinata* is too short and indefinite to be of much service, but it fits as well as any other the *carinata* of the Le Conte collection, which is also (and probably in consequence) the *carinata* at least in part of the most reliable modern collections, and of numerous bibliographical references. In the absence of any definite contradictory evidence this species should continue to bear the name *carinata*. It is not at all similar to *torquata*, but is closely related to *chalybea* and *ignita;* it is the *ulmi* of Woods.

In the Horn Collection specimens of this species are included both with *torquata* in his *carinata* series and with his *ignita* series. The former association is difficult to understand, as they do not at all closely resemble one another, but it explains two confusing

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statements in his Synopsis. In the table of species *carinata* is characterized as having the ante-basal groove of the thorax moderately deep, evanescent at the extremities and never entire. In the remarks preceding the table of species he says that specimens of *carinata* occur with the impressed line as entire as in *chalybea*. The former statement, as well as the words "bright coppery red with bluish or purplish reflections," is evidently drawn from *torquata*, while the latter statement applies to the true *carinata*. Incidentally it may be remarked that the expressions, "ante-basal groove deep and entire" or "moderate and not entire," which look quite definite and satisfactory on the printed page, are really very difficult to apply in practice. Looked at from one position you unhesitatingly pronounce the groove entire, but viewed from a different angle you are quite as positive it isn't. The only course left to you is to try both roads, but this is no unusual thing in the use of taxonomic keys. But to come back to the *H. torquata* of Woods; if this is not the true *torquata*, what is it? Malloch has assumed it to be an undescribed species, and has proposed the name *sylvia*. This action I fear is premature. A specimen taken by myself at Tyngsboro, Mass., September 1, 1916, has been compared by me with Blatchley's type of *cuprascens* and proved so closely similar that I felt no hesitation in attaching that name to it. A Michigan example sent me by Dury, and others from Michigan, recently seen in the National Museum Collection are quite certainly the same thing, and I have little doubt are identical with Blatchley's type.

That very careful and painstaking work was done by Mr. Woods on the biologies of the Maine Halticas is obvious from a perusal of his report, which constitutes a valuable contribution to the recorded life histories of our coleoptera. The results of his work have thoroughly convinced him of the specific distinctness in all stages of three forms "that in Horn's Monograph would fall under the single species *ignita* Illig." To these he gave the names *corni*, *rosæ* and *ulmi*. As has been stated above, *ulmi* is to the best of our belief the *carinata* of Germar, so that two only are created at the expense of *ignita*. The writer has for some time inclined to the belief that the *ignita* complex would ultimately be broken up into a number of distinct species by more careful study coupled with an association with their food plants; he is, therefore, disposed to

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accept the conclusions of Mr. Woods, at least until further evidence is forthcoming. On the other hand it must be conceded, that aside from color and size, which may mean much or very little, the differences as presented are all very small and not entirely constant. While a difference in food plant is always suggestive, it is of course by no means necessarily indicative of specific distinctness, the accompanying differences in color, etc., being quite conceivably no higher than racial in character. Mr. Woods' experiments show that the larvæ of all the forms studied could be induced to feed more or less readily on a considerable variety of plants. Apparently no effort was made to carry them through to maturity on any other than their preferred food plant, though the results of such effort, especially if successful, would have been of great interest, as would the results of attempts at cross breeding. Such experimentation is often difficult of accomplishment, and under the most favorable conditions involves skilled handling and a great deal of time. It is to be hoped however that Mr. Woods or some equally competent investigator may continue the work so well begun.

It should be noted that two statements in Woods' "Key to the Adults," on page 154, are more or less misleading. The antennæ of *ulmi* are said to be "one-half the length of the body." This certainly is not always true, since in one of the two typical examples sent me the antenna is extended along the side of the body in good position for comparative measurement and is quite three-fifths as long as the body. Again, the so-called "*ignita* of Chittenden" is said to have "segment 3 of the antennæ longer than segment 4." This is not true of any Haltica in our fauna, unless possibly as an accidental individual variation.

In this connection it becomes of interest to know just what the "*ignita* of Chittenden" is. Referring to his article on "The Strawberry Flea-Beetle"[1] it appears that so far as the beetle is described, it is the broadly conceived *ignita* of Horn's Synopsis, varying in color "from bright metallic golden, coppery, golden brown or purplish, to green and blue" and ranging in distribution from ocean to ocean and from Canada to Mexico. This does not help us any, but some observations made further on in the account of the life history as worked out by the author, supplemented by numerous specimens and some additional data kindly submitted to me by

[1] Some Insects Injurious to Garden Crops, Bull. 23 N. S. U. S. Dept. Agric. 1900.

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Dr. Chittenden himself, show conclusively the species which may properly be called the "*ignita* of Chittenden," that is to say, the species whose life history he portrays is the *H. litigata* described some ten years ago by the writer, from Florida specimens. In the material from the Department Collections, sent me for examination by Dr. Chittenden, there are many of this species which so far as known to me ranges from the District of Columbia and Ohio to Florida and Texas, and is evidently common or even abundant in this region, and though partial to strawberry, the beetles at least are inclined to be quite polyphagous, especially when swarming. The pin labels on specimens sent by Chittenden indicate the occurrence of the species on rose at Biloxi, Miss.; on *Œnothera biennis*, "reared from egg indoors," Biloxi, Miss.; on crêpe myrtle at Norfolk, Va., and Melbourne, Fla.; on strawberry at Orlando, Fla., Bellemont and Paget, Bermuda, and Tickfaw, La.; on turnip, Bee County, Tex.; on lettuce and on *Gaura sinuata* at Brownsville, Tex.; on Fuchsia at Washington, D. C. There is no mention whatever of larvæ in the departmental notes relative to the above, except in the case of *Gaura sinuata* at Brownsville, where on March 5, 1909, were found "larvæ eating leaves" and eggs also collected. Gaura is nearly related botanically to Œnothera, and both are undoubtedly natural food plants of this insect.

Referring now to the biologic records, pages 74–76 of Bulletin 23, we may say with considerable certainty that in all mentioned cases of injury to strawberries in Florida, North Carolina, Maryland and Indiana, and to Fuchsia at St. Louis, Mo., the culprit was *H. litigata*. The species reported as feeding on grape at Tempe, Ariz. (Insect Life, Vol. I, p. 220) is without much doubt the *H. torquata*. This, under the name *carinata*, is also reported by Coquillet as feeding on grape at Los Angeles, Calif., and one of his specimens is now before me. The Minnesota "lesser grape vine flea-beetle" of Lugger is in all probability the "sixth" Maine species referred to by Woods, pages 150–151, and found by him on two occasions on woodbine. To this species Woods gave a manuscript name and sent me specimens suggesting that I describe it. On a recent visit to the National Museum at Washington, Mr. Schwarz showed me a long series of a new Haltica of which the life history had been worked out and a description written and already submitted for publication by Mr. Iseley of the Department of

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Agriculture. I believe this to be the same as Woods' sixth species and Lugger's grape vine species. As for Bruner's Nebraska species and Gillette's Colorado species nothing definite can be said; Chittenden's brief references give no clue and probably the original articles would be insufficient for identification even if they were accessible to me.

The species occurring on laurel, the *kalmiæ* of Melsheimer, I believe as did Horn, notwithstanding the mysterious "plica submarginali," to be the typical *ignita* of Illiger. It is highly improbable that a distinct species of Haltica with a normal submarginal elytral plica, but otherwise agreeing with our laurel species, can exist in the Atlantic region and no specimens of it have turned up in the more than one hundred years since Illiger published his description. In a recent conversation with Mr. Schwarz, he expressed the opinion that this elytral fold was apt to appear fortuitously in any species of Haltica, more especially in the females. Apropos of this observation, there are now before me three examples of a small Haltica (2♂'s 1♀) recently sent me by Chittenden, in the female of which there is a tolerably well defined lateral elytral plica, while the males show slight traces of it. These specimens were collected at West Springfield, N. H., on Lombardy plum. They resemble greatly and probably are the *H. rosæ* of Woods; however, they diverge slightly from my typical examples of *rosæ*, and in the direction of *ignita* (*kalmiæ* Melsh). What I take to be typical examples of the latter differ from typical *rosæ* in their more brilliant color, slightly larger size, more coarsely punctate elytra, and in having the hind margin of the thorax slightly sinuate each side of the middle so as to present a small median lobe. In my typical *rosæ* there is no trace of such a lobe, but this character is probably not entirely constant, nor are either of the others very dependable. In addition to typical *rosæ*, *corni* and *ulmi*, I received from Mr. Woods specimens of another form, of which he wrote as follows: "I have taken another member of the *ignita* group on laurel and am sending specimens under separate cover. I am calling it *kalmiæ* MS. This runs close to *rosæ* in every character, as far as eggs, larvæ and pupæ are concerned." From the above it must be obvious that *rosæ* and *ignita* (*kalmiæ* Melsh = *kalmiæ* Woods MS.) are exceedingly close if actually distinct, and that the Lombardy plum female with the submarginal plica might serve very well for

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the type of Illiger's description. It will be of interest to note that laurel was not among the food plants offered the *rosæ* larvæ in Woods' experiments, but that wild plum was offered and refused.

The following additional biologic notes gleaned from the material sent me by Chittenden may well be put on record at this time, but it should be borne in mind that unless otherwise stated it is only the beetles that were found upon the plants, and that in some instances, at least, the visitation probably has no economic significance whatever.

H. bimarginata Say. Intervale, N. H., bred from alder; Gardiner, Me., collected on alder; Brownsville, Tex., feeding on willow; Guadalupe, Cal., on willow. This is the well-known alder flea-beetle; its occurrence on willow is more exceptional.

H. carinata Germ. Mont Alto, Pa., on elm.

H. chalybea Ill. Orlando, Fla., and Warrenton, Va., on grape.

H. evicta Lec. Moscow, Idaho, on strawberry.

H. foliacea Lec. Tecumseh, Okla., "Coll on apple"; Garden city, Kans., "feeding on weeds"; Childress, Tex., "on sugar beets."

H. knabii Blatch. Marshall Hall, Md., reared from larvæ taken in field on *Œnothera biennis*. The specimens bear the label *H. fuscoænea* Melsh, as they probably do in other collections.

H. probata Fall. San Luis Obispo, Calif., "on wild rose."

H. suspecta Fall. Corcoran, Calif., "on sugar beets."

H. vicaria Horn. Fort Collins, Colo., "Sugar beets." I do not think it likely that either of the last two species attack beets in the larval stage or that the beetles will prove a menace to crops.

To the systematist the genus Haltica offers very great difficulties; hence the especial need for the illumination which the complementary work of the biologist may shed upon the obscure relationships of the *ignita* group. While we have as yet no record of the food plant or habits of *H. inærata* Lec. of the Manitoba region, an examination of the type convinces me that it should be restored to specific standing. It should probably be associated with *ignita* and allies, but it differs more from either *ignita*, *rosæ* or *corni* than they do from each other. The ante-basal groove of the thorax, though entire, is less deep than in either of these, the form rather narrower and less broadly shouldered, the color brown bronzed, the elytra typically with a faint greenish reflection which is often lacking. The resemblance of *inærata* to *obolina* of the Pacific

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region is more marked than to any of the eastern forms, but the basal impression of the thorax is much stronger than in the latter. I have seen a good series of *inærata* collected at Winnipeg and Husavick, Manitoba (Wallis).

There are yet a considerable number of probably new species in my collection, of which the following four may I think be described at this time in a recognizable manner.

Haltica purpurea sp. nov.

Oval, moderately elongate, dark bronze, the elytra with distinct purple lustre, surface shining. Head and thorax very finely alutaceous, varying to scarcely visibly so; elytra distinctly alutaceous. Antennæ piceous, about $\frac{3}{5}$ as long as the body, 4th joint slightly to scarcely longer than the 3d, fully twice as long as wide; 10th not quite twice as long as wide. Head $\frac{4}{5}$ as wide as the prothorax, eyes only moderately prominent, their width as seen from the front evidently less than half the interocular distance; vertex contiguous to the flattened tubercles smooth, almost without punctures. Prothorax $\frac{2}{3}$ as long as wide, sides narrowly margined, narrowed in front, subparallel in basal half and either with or without a feeble sinuation before the hind angles; punctuation sparse and minute, ante-basal impression fine and sharply defined, but not deep and not quite attaining the sides. Elytra distinctly oval in outline, widest at the middle, not quite $\frac{1}{2}$ wider than the thorax in the male, the female a little stouter; punctuation much more distinct than that of the thorax, but rather fine, the punctures separated on the average by about twice their own diameters, intermixed finer punctures almost entirely lacking. Body beneath and femora piceous, more or less distinctly purpureous; tibiæ and tarsi scarcely metallic. Last ventral of male with the usual apical lobe and smoother median impression. Length, 3.3 to 3.8 mm.; width, 1.8 to 2.1 mm.

Described from a series of 3♂'s, 1♀, taken at Tyngsboro and near Lowell, Mass., by the late Frederick Blanchard, from whom I received them.

An attempt to place this species by Horn's table through a strict interpretation of the characters there used is likely to prove abortive. The oval form of the elytra is quite suggestive of the much larger *californica* and *obliterata*, as well as *cuprascens* Blatch.

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and the smaller *fuscoænea*. My suggestion would be that these five species together with *heucheræ* sp. nov., the description of which follows, should be associated in the following order: *obliterata*, *californica*, *cuprascens*, *purpurea*, *heuchræ*, *fuscoænea*. *Purpurea* is probably nearest *cuprascens*, the latter differing in its cupreous coloration, rather larger size and more elongate form, feebler pronotal groove, usually finer elytral punctuation and longer fourth antennal joint, which is three times as long as wide and decidedly longer than the third joint. There are numerous specimens of this species in the Blanchard Collection, now in the Museum of Comparative Zoölogy at Cambridge, Mass. The type is a male labeled "near Lowell, Mass."

Haltica heucheræ sp. nov.

Moderately elongate, head and thorax cupreoæneous, with feeble violaceous lustre, elytra distinctly purpureo-violaceous. Antennæ scarcely more than half the length of the body, piceous, joints 2–4 testaceous, several of the following joints more or less rufous basally; joints 3 and 4 subequal, the latter at most only slightly longer, 4th joint twice as long as wide, 10th scarcely more than ½ longer than wide. Head smooth, polished; eyes smaller than usual, feebly prominent, their width as viewed from the front much less than half the interocular distance. Prothorax quadrate, less than ½ wider than long, sides parallel, rather strongly margined, feebly arcuate medially, surface finely alutaceous, and finely rather sparsely punctate; ante-basal groove moderately deep and practically entire. Elytra suboval, humeri narrow and broadly rounded, sides feebly arcuate or (♂ type) straight and parallel for a short distance at middle; surface distinctly alutaceous and rather coarsely punctate, intermixed finer punctures scarcely evident. Body beneath and legs, except tarsi, piceous with purplish surface lustre. Male with the last ventral segment lobed and impressed as usual. Length, 3.5 to 3.8 mm.; width, 1.7 to 1.85 mm.

Described from four examples (type ♂) collected by Mr. Norman Criddle at Aweme, Manitoba "25-IX-1916," on *Heuchera hispida*. The specimens were sent me by Mr. J. B. Wallis, in whose collection are paratypes. The quadrate thorax and oval elytra suggest association with *fuscoænea*, before which this species may be placed as indicated in the remarks following the preceding

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description. It is much larger than *fuscoænea*, of different color, with smaller less prominent eyes, more distinctly punctate thorax with deeper ante-basal groove, and entirely dark legs.

Haltica blanchardi sp. nov.

Elongate oblong, green, elytra slightly, thorax rather strongly æneous. Antennæ a little longer than half the body; piceous, with slight metallic lustre; joints 3 and 4 subequal. Eyes prominent, their width as seen from the front nearly equal to half the interocular distance. Head above the frontal tubercles not visibly alutaceous and nearly impunctate. Prothorax $\frac{1}{3}$ wider than long, sides parallel in basal half, convergent in front, subangulate medially, side margin moderate, surface plainly alutaceous, distinctly though finely punctate, basal groove rather wide, vaguely attaining the sides, sharply impressed at bottom, this sharper impression terminating before reaching the margins; hind margin broadly angulate at middle. Elytra oblong, not quite twice as long as wide, sides parallel for $\frac{3}{4}$ their length, surface distinctly alutaceous and rather coarsely and closely punctate with scattered minute punctures intermixed. Body beneath and legs piceous with distinct purple metallic lustre. Length, 3.1 mm.; width, 1.4 mm.

Three examples only of this species are known to me; the type, taken by myself at Tyngsboro, Mass., July 6, 1893, and two other examples in the Blanchard Collection, also taken at Tyngsboro. In size and form it agrees very closely with *amæna* Horn and *vaccinea* Blatch., and with them only. In both these species the color is more decidedly cupreous, and in neither of them is the surface sculpture so marked as in *blanchardi*, which has a finely scabrous aspect. In *amæna*, described from a unique example from Georgia, the elytral punctuation is about as coarse but less dense than in *blanchardi*, the thorax obsoletely punctulate, the basal impression not quite so strong though quite sharply defined. Horn's statement that the antennæ are slightly longer than the body is a manifest inaccuracy, nor should I describe the humeri as oblique. The Floridian species *vaccinea* differs notably from *blanchardi* in its smaller less transverse prothorax, with nearly straight feebly converging sides, and with polished almost imperceptibly punctate surface.

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Haltica vialis sp. nov.

Oblong oval, color above and beneath including the legs purpureo-violaceous; sutural region especially toward the base, with greenish reflections. Antennæ dark throughout, feebly metallic, third and fourth joints subequal. Eyes not very prominent, their width viewed from in front less than half the interocular distance. Head smooth posteriorly; vertex, contiguous to the flattened tubercles coarsely punctate from side to side. Prothorax moderately transverse, a little narrower in front, widest behind the middle, sides broadly arcuate, feebly convergent basally, more noticeably so anteriorly; surface scarcely visibly alutaceous, closely comparatively coarsely punctate; ante-basal groove rather feeble, shallow and incomplete. Elytra oblong, slightly oval, sides very broadly arcuate, surface a little more coarsely punctate than the thorax but scarcely as closely so. Body beneath often with greenish reflections. Male with last ventral lobed as usual and with an unusually deep polished median longitudinal impression in posterior half. Length, 4.7 to 5.1 mm.; width, 2.2 to 2.5 mm.

The type is a male and is one of two examples taken by myself at Raton, New Mexico, November 8, 1889. The specimens were taken, if I remember correctly, under shelter of some sort near the railway station while stopping for lunch on my first transcontinental trip to California. I have since similarly taken the species at Seligman, Ariz., and have an example from Flagstaff, Ariz., taken by Dr. Fenyes. There are examples in the Le Conte Collection from Colorado and western Kansas (Popenoe), and in the Horn Collection from Colorado, in both cases placed with the superficially rather similar *torquata*, and both combined with the very different eastern *carinata*, a mix-up that it is certainly difficult to comprehend. Compared with *torquata* the present species is rather larger and more robust, with a much larger thorax and conspicuously coarser punctuation throughout. The ante-basal groove of the thorax is also less sharply defined and the last ventral of the male more deeply impressed.

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DESCRIPTIONS OF SOME NEW TROPICAL PACHYGASTRINÆ.

By Charles W. Johnson,
Boston Society of Natural History.

In describing a species of Psephiocera from Jamaica, my attention was called to two apparently new species, representing one Psephiocera and one Chalcidomorphina from British Guiana. The above genera by Dr. Enderlein cover these forms, while a paper by Dr. Kertész enables us positively to determine Cynipimorpha. With the limited material at hand, it is with some misgivings that I offer this paper, but the difficulty of obtaining smaller species from that region is so great that years slip by and they remain undescribed. For instance, the specimens at hand have been in my possession over eighteen years. It is to be hoped that the following bibliography and table of species will aid future workers.

Cynipimorpha bilimeki Brauer. Fig. 1.

C. bilimeki Brauer, Denkschr. der K. Akad., Wien, XLIV, 75, 1882; Kertész, Ann. Mus. Nat. Hung., VI, 343, Tab. 6, Figs. 1, 2, 1908.

In the latter paper Dr. K. Kertész has carefully redescribed Brauer's type and figured the antenna, thus enabling one to readily identify this species which otherwise would have continued to cause confusion among the closely related genera and species. I herewith reproduce the figure given by Kertész. The genus has been emended to *Cynipomorpha* by Enderlein, but the original spelling will have to stand.

Psephiocera Enderlein.

Zoölogischer Anzeiger, 1914, Band 43, p. 300. Type *P. flavipes* Enderlein.

Table of Species.

1. Tomentum forming lines on the disc of the thorax 3
   Tomentum covering the entire thorax 2
2. Scutellum and part of the pleura with light tomentum (Mexico) *minuta* Will.
   Scutellum with black tomentum, pleura shining black without tomentum (S. Brazil) . . . . . *flavipes* Enderl.

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3. Thorax with three lines of light tomentum which is also present on the sides, and on the middle of the pleura (Jamaica) *metzi* Johns.

Thorax with a dorsal line of light tomentum, expanding into a large patch in front of the scutellum, also present on sides and on part of pleura (Brit. Guiana)....*dorsata* sp. nov.

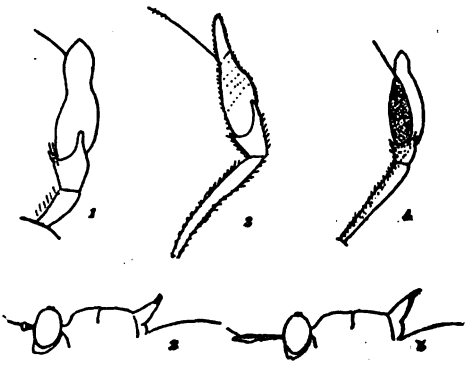

Fig. 1. Antenna of *Cynipimorpha bilimeki* ♂, after Kertész; Fig. 2, scutellum of *Psephiocera minuta;* Fig. 3, antenna of *Chalcidomorphina aurata* ♀, after Enderlein; Fig. 4, antenna of *Chalcidomorphina crewi* ♀, Fig. 5; Scutellum of same.

Psephiocera minuta (Williston). Fig. 2.

Cynipimorpha minuta Williston, Biol. Cent. Amer., Vol. I, p. 252, Tab. 4, Figs. 19, 19a, 1901; Kertész, Ann. Mus. Nat. Hung., Vol. 4, p. 343, 1908.

Psephiocera minuta Enderlein, Zoöl. Anz. Band 43, p. 302, 1914.

Eucynipimorpha minuta Malloch, Ann. Ent. Soc. Amer., Vol. 8, p. 312, 1915.

As pointed out by Dr. K. Kertész this species cannot be placed in the same genus with *Cynipimorpha bilimeki* Brauer on account of the great difference in the antennæ. It was later placed by Dr. Enderlein in the above genus. A specimen in my collection from Mexico agrees with Williston's description except that the femora are yellow with a slight brownish tinge below, and not "except the tips, nearly black." This is evidently a variable character and the specimen probably represents the extreme range of variation in this respect. The third joint of the antennæ under a hand lens (12 diameters) is "finely roughened" but under the binocular with

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an enlargement of from 25 to 60 diameters the annuli show distinctly and the roughening is due to rows of minute granules on the annuli; the third joint is yellow with a dark brown spot at the base. In this respect the genus seems to be closely related to Neopachygaster, the glossy brown spot on the antennal joint, which Malloch refers to as "possibly of a sensory nature," is here largely developed. The only other character that seems to separate the two genera is the form of the scutellum. The side view given of *C. minuta* (fig. 19a) shows two small dorsal protuberances at the suture that are not mentioned in the description, nor are they shown in the dorsal view (fig. 19).

Psephiocera metzi Johnson.

Diptera of Jamaica, Amer. Mus. Nat. Hist., Vol. 41, p. 427, 1919.

The apex of the scutellum is slightly shorter and less attenuated in this and the following species, than in *P. minuta* Will.

Psephiocera dorsata sp. nov.

♀ Front black, orbital margins whitish, face white, antennæ yellow, the third joint with five narrow annuli, with a small brown basal spot, arista yellow. Thorax black when viewed from above, the yellowish tomentum forming a dorsal line extending just beyond the suture where it expands into a broad patch in front of the scutellum; there is also an obsolete transverse band in front of the suture; from the humeri large patches of whitish tomentum extend to the base of the wings and across the pleura; base of the scutellum with yellowish tomentum. Abdomen black, looking from behind the fourth segment has three lines of white tomentum, with only the dorsal line showing on the fifth segment, third segment with only a lateral patch when viewed from the side. Legs yellow, femora except at the tips dark brown, front tibiæ also brown, halteres white. Wings hyaline, costa and first longitudinal vein dark brown, stigma yellow, length, 3 mm.

One specimen, Bartica, British Guiana, May 28, 1901 (R. J. Crew). Type in the author's collection.

Chalcidomorphina Enderlein.

Zoologischer Anzeiger, 1914, Band 43, p. 298. Type *C. aurata* Enderlein.

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Chalcidomorphina aurata Enderlein. Fig. 3.

Zoologischer Anzeiger, 1914, Band 43, p. 299, figs. 4, 5. Columbia.

The principal character that separates this from the following species is the form of the antennæ. The scutellum of the genotype was missing, but it is probably similar to the following species which is here figured.

Chalcidomorphina crewi sp. nov. Figs. 4, 5.

♀ Face black, whitish pollinose, front black shining, with white orbital spots midway between the vertex and antennæ, from these very narrow orbital lines extend to the face, ocelligerous tubercle prominent, ocelli yellow, antennæ situated about the middle of the head in profile, blackish above and yellow below, first joint slender, about as long as the second and third combined, third joint broadened and somewhat flattened above and minutely flecked with white. Thorax black, with a dorsal line, a narrow transverse band at the suture, and a broad band near the base of the scutellum of yellow tomentum, on the humeri and pleura whitish, scutellum black, the tip longer and more attenuated than in the species of the genus Psephiocera, abdomen black, with a grayish pollinose arcuate band at the posterior margin of the third and anterior margin of the fourth segment, and a V-shaped marking at the end partly on the fourth and partly on the fifth segment. Legs yellow, the anterior femora brownish, halteres white. Wings hyaline with a slight brownish tinge, more noticeable toward the tip, veins brown, stigma yellow, middle portion of the costa and tip of the first vein dark brown, third vein branched. Length, 3 mm.

One specimen collected by Mr. R. J. Crew, at Bartica, British Guiana, July 3, 1901. Type in the author's collection.

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NOTES ON THE LINES OF DESCENT OF LOWER WINGED INSECTS.

By G. C. Crampton, Ph.D.,
Massachusetts Agricultural College, Amherst, Mass.

In the February issue of the *Entomological News* for 1919 (Vol. XXX, p. 42) the lines of descent of the Orthoptera and their immediate relatives, were discussed from the standpoint of the comparative morphology of recent forms; but no attempt was made at that time to bring the results into harmony with the conclusions of Handlirsch, 1909 (Die Fossilen Insekten), who has attacked the problem from the standpoint of palæontology. I would, therefore, offer the following brief suggestions as to the location of the lines of descent of certain of the fossil forms described by Handlirsch, in the general scheme of the interrelationships of living insects. It should be borne in mind, however, that since the earlier fossil forms are known almost exclusively from their wing-venation, the position they are assigned in the general scheme is largely conjectural, and must remain so until more of their anatomical details than the few incomplete fragments thus far brought to light are known—for the wing-venation alone (or any other one set of structures) is entirely insufficient evidence upon which to base one's conclusions as to the interrelationships of insects. A good illustration of this point is furnished by the fossil insect *Eugereon*, in which the wings are very conservative (*i. e.*, but slightly modified) while the head has proceeded far along the road to specialization—so much so, in fact, that it would be practically impossible to place *Eugereon* correctly in the general scheme, if it were known only through the venation of its wings. In the recently discovered winged Zoraptera (Proc. Ent. Soc. Washington, Vol. 22, p. 84, and p. 98), on the other hand, the wings are quite highly specialized, while the body structures are quite conservative, and if the detached wings were the only structures known, it is very doubtful if we would be able to place these insects in their correct position next to the line of development of the Isoptera.

As was pointed out in the August, 1919, issue of the Transactions of the Entomological Society of London (p. 93), the Ephemerida, Odonata, and certain Palæodictyoptera form a group characterized by their inability to fold their wings flat along the top of the ab-

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domen, and in an article in the May, 1920, issue of the Proceedings of the Entomological Society of Washington (Vol. 22, p. 98) these insects, together with their immediate relatives (*i. e.*, the Protephemerida, Ephemerida, Protodonata, Odonata, certain of the Palæodictyoptera, etc.), were grouped in an ancestral superorder of insects called the Panpalæodictyoptera, or Panplectoptera (from Packard's term "Plectoptera," applied to the Ephemerida). The lines of development of these insects are shown in Fig. 1, although all of the fossil forms are not represented in the diagram.

As is indicated in Fig. 1, the fossil Palæodictyoptera occupy a position at the base of the lines of descent of other winged insects, and have apparently departed as little as any known forms from the first types of winged insects to be evolved. Some of the insects usually included in the order Palæodictyoptera are apparently more closely related to the insects grouped about the Plecoptera, and should be included in the next superorder (Panplecoptera).

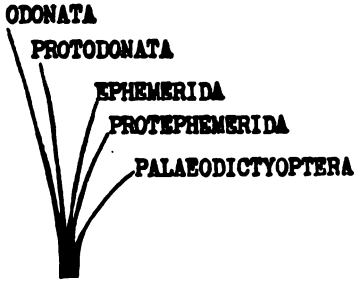

Fig. 1. Lines of descent of the Panplectoptera.

The Ephemerida are in some respects intermediate between the Palæodictyoptera and the Plecoptera (together with certain other forms), and they also exhibit certain archaic features carried over from their Apterygotan forebears—for winged insects were undoubtedly derived from ancestors closely resembling the Lepismidæ and other Apterygota, and could not possibly be derived directly from the Trilobita as Handlirsch would have us believe! The Ephemerida have also retained certain features suggestive of Crustacean affinities, and a study of their anatomy (particularly of the immature stages) is of considerable value in tracing the evolution of the higher forms. Handlirsch considers that the Ephemerida were derived from the fossil Protephemerida, and that the Odonata

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were derived from the fossil Protodonata, and the lines of development of these forms were therefore placed close together in the diagram. The Odonata are apparently fairly closely related to the Ephemerida, but their line of development leads away from that of most of the other insects, and they are such highly aberrant forms that a study of their anatomical features is of but little value in attempting to trace the lines of descent of winged insects in general.

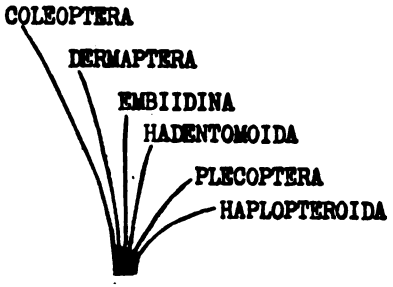

Fig. 2. Lines of descent of the Panplecoptera.

In Fig. 2, the lines of descent of the insects comprising the superorder Panplecoptera (*i. e.*, the Haplopteroida [fossil], Plecoptera, Hadentomoida [fossil] Embiidina, Dermaptera, Hemimeridæ, etc., and possibly including the Coleoptera as well) are shown. If we take into consideration only the Plecoptera, Embiidina, and Dermaptera, the group is characterized in general by a tendency toward the prognathous type of head (*i. e.*, mouthparts directed forward), the presence of three segments in the tarsi, and the absence of styli on the posterior margin of the hypandrium, or sternal plate beneath the genitalia of the male insect. The mesothoracic coxæ are usually as broad, or broader than long in these insects, and there is a marked tendency toward the retention of the longitudinal, rather than the cross veins of the wing in the members of the group.

Handlirsch states that the fossil Haplopteroida are closely related to the Plecoptera and that the fossil Hadentomoida are closely related to the Embiidina, so that the lines of descent of these forms have been represented as though extending rather close together in the diagram. The Haplopteroida are in some respects more specialized than the Plecoptera, and their line of descent

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should have possibly been placed above that of the Plecoptera in the diagram.

Of the living forms, the Embiidina are the closest relatives of the Plecoptera, the two lines of development paralleling one another remarkably closely. The Plecoptera are the more primitive of the two, however, and have departed as little as any known living insects, from the condition typical of the ancestors of the other insects of the group—and of the remainder of winged insects as well. The Dermaptera are related to both Embiids and Plecoptera, and are intermediate between these insects and the Isoptera in many anatomical features. The Dermaptera are also extremely like the forms ancestral to the Coleoptera in regard to their maxillæ, antennæ, terga, wing bases, elytra, cerci (compare larvæ of Carabidæ with immature earwigs such as *Dyscritina*, *Karschiella*, etc.), etc., and the members of the superorder Panplecoptera exhibit many other features which must have been present in the ancestors of the Coleoptera (compare head region of *Harpalus* and *Embia*, leg structures etc.). On the other hand, the Neuroptera (and in some respects the Hymenoptera also) are remarkably like the Coleoptera especially with regard to the structural details of the larvæ, so that the Coleoptera could equally well be placed in the superorder Panneuroptera (to which the Neuroptera, Hymenoptera, etc., belong) as in the superorder Panplecoptera, and on this account the Coleoptera have been grouped with the Neuroptera only provisionally, until I am able to find the forms which will enable me to determine definitely whether the closest affinities of the Coleoptera are with the Dermaptera and their allies, or with the Neuroptera and their allies. Anatomically, the Coleoptera are clearly intermediate between the Neuroptera and Dermaptera, and the ancestors of the Coleoptera were apparently intermediate between the Isoptera on the one hand, and the Dermaptera, with their allies, on the other, although the "roots" of the Coleopteron stem strike down deeply toward the Embiid and Plecopterous types of insects.

The Zoraptera, Isoptera, Mantida, Blattida, and the fossil Protoblattida, with their immediate relatives, constitute the superorder Panisoptera, whose members are characterized chiefly by the markedly asymmetrical development of the genitalia of the male insect, although this does not hold true of the Isoptera, in which

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the genitalia of the male are not sufficiently well developed to be readily seen. The hypandrium, or sternal plate below the genitalia of the male, frequently bears a pair of styli on its posterior margin, in these insects, and cerci are present in practically all of them. The mesothoracic postscutellum is vestigial in the winged forms of most of these insects (excepting the Zoraptera) and the mesothoracic coxæ are longer than broad in the greater part of the insects constituting this superorder. The lines of descent of these insects are represented in Fig. 3.

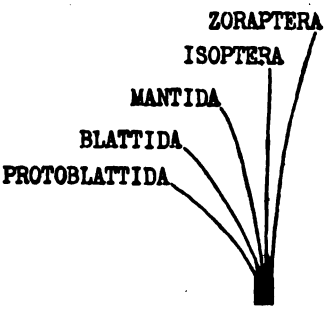

Fig. 3. Lines of descent of the Panisoptera.

Since Handlirsch maintains that the Protoblattida are intermediate between certain of these insects and the Palæodictyoptera, the line of development of the Protoblattida has been represented as the lowest in the diagram (Fig. 3), although not very much is known of the structural details of the Protoblattida, to justify this. The more immediate ancestors of the insects comprising this superorder (Panisoptera) were doubtless very like the Plecoptera and their allies, although the *ultimate* ancestral types of these insects and the Plecopteroid forms as well, are doubtless to be sought among the members of the Palæodictyopteroid group. Indeed, the more the Protoblattida depart from the Blattid and Mantid type, the more closely do they approach the Plecopteroid type, thus indicating that the latter forms resemble the immediate ancestral forms from which the Panisoptera were derived.

The Blattida and Mantida are extremely closely related and their lines of descent have been represented quite close together in the diagram. Taken alone, it would be rather difficult to determine

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what living insects are the nearest to the ancestral type from which they were derived; but their near relatives, the Isoptera, are intermediate between the Mantid-Blattid forms and the insects related to the Plecoptera, such as the Dermaptera and Embiidina, and thus serve to connect the two groups. The Isoptera are in some respects more highly specialized than the Blattida; but in other features they are much nearer the ancestral Plecopteroid type, and might, therefore, be considered as in a sense more "primitive" than the Blattida. The Zoraptera are very close to the Isoptera; but have preserved many characters present in the Plecopteroid group. In fact, they are anatomically intermediate between the Isoptera on the one hand, and the Plecoptera (such as *Leuctra*, *Capnia*, etc.) on the other, as was pointed out in a recent article in the Proceedings of the Entomological Society of Washington (Vol. 22, p. 98). They thus serve to connect the Isoptera with the Plecopteroid group, and the Isoptera in turn serve to connect them with the Mantida and Blattida. Furthermore, the Zoraptera are remarkably similar to the ancestors of the Psocidæ, the Thysanoptera, and the Psyllid Homoptera, and are very suggestive of the forms leading to the Hymenoptera and Neuroptera, so that a study of their anatomical details is of the utmost importance in attempting to determine the paths of evolution of the higher forms.

The fossil Protorthoptera, the Grylloblattida, Phasmida, and saltatorial Orthoptera, with their immediate relatives, constitute the superorder Panorthoptera, whose lines of descent are represented in Fig. 4. The ovipositor of the female insect is unusually well developed in many members of this group, and many of them exhibit a tendency toward a thickening of the forewings, which are typically parchment-like in character. The cerci are usually reduced to a single segment (but not in *Grylloblatta*) and there is a tendency toward a reduction of the number of tarsal segments to four or less, in many members of the group. The males of some of these insects have retained a pair of styli on the posterior margin of the hypandrium (ninth sternite), and the genitalia are for the most part of a peculiar, highly modified type (excepting *Grylloblatta*).

Since Handlirsch maintains that the fossil Protorthoptera are very like the ancestors of the insects in question, their line of descent is represented as among the lowest of those shown in Fig. 4. Such forms as *Grylloblatta* and the interesting little Phasmid

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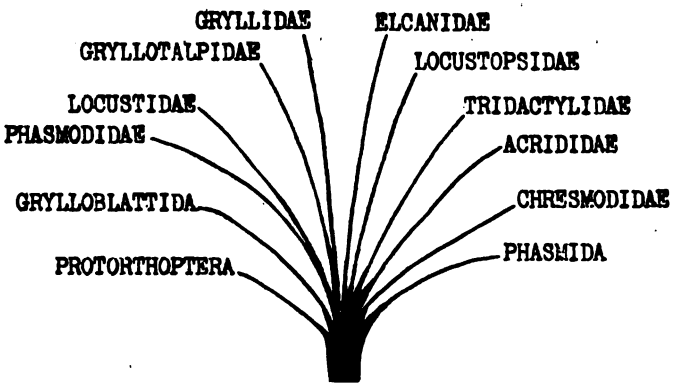

Fig. 4. Lines of descent of the Panorthoptera.

Timema, however, give us a much better idea of the structural details of the lower representatives of the group, since the fossil forms are too poorly preserved for this purpose. *Grylloblatta* is structurally intermediate between the Zorapteron-Isopteron group and the Dermapteron-Embiid group of insects, while *Timema* exhibits more Plecopteroid characters than *Grylloblatta* does. In fact *Timema* exhibits such pronouncedly Plecopteroid features that there can be no doubt that the Plecoptera and their relatives represent the ancestral forms from which such insects as *Timema* (and hence those insects grouped with it) were derived. Of the other Orthopteroid insects, the Gryllidæ and "Locustidæ" (Tettigonidæ) are very like *Grylloblatta*, while the Acrididæ (*i. e.*, true Locustidæ) and Tridactylidæ are nearer the Phasmidæ.

According to Handlirsch, the fossil Chresmodidæ are very closely related to the Phasmidæ, and are intermediate between the Phasmidæ and the fossil Elcanidæ, from which Handlirsch would derive the Tridactylidæ. Handlirsch derives the Acrididæ from the fossil Locustopsidæ, and he considers that the Elcanidæ and Locustopsidæ are somewhat intermediate between the Acrididæ and the Locustid-Gryllid group, so that they have been assigned this position in the diagram shown in Fig. 4—although the diagram in question is somewhat different from that given by Handlirsch to illustrate the interrelationships of the forms in question, especially with regard to the position assigned to the Phasmidæ, which Hand-

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lirsch considers as derived forms, rather than as primitive representatives of the types ancestral to the saltatorial Orthopteroids. Handlirsch, however, has reversed the evolutionary sequence in other instances as well, since he would derive the anatomically and embryologically more primitive Dermaptera from Gryllidæ, and the fact that he derives the Hemimeridæ (which are really a suborder of the Dermaptera) as a distinct offshoot of the Gryllidæ, would make it seem probable that he is not very familiar with the anatomy of the insects in question.

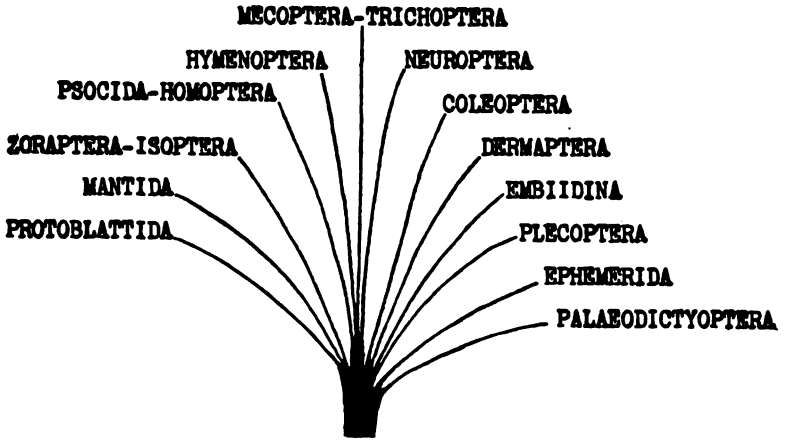

Fig. 5. Lines of descent of higher insects.

In Fig. 5, are shown the interrelationships of the insects occupying a position near the base of the lines of descent of the higher forms. The most important of these are the Zorapteron-Isopteron group, and the Coleoptera with the Dermaptera, since the lines of descent of the Zoraptera, the Hymenoptera and the Neuroptera were derived from ancestors intermediate between these insects, while the Psocidæ, Hymenoptera and Neuroptera are in turn intermediate between these insects and the higher forms such as the Homoptera, Mecoptera, Trichoptera, etc. Thus, the Psocida were evidently derived from ancestors extremely similar to the Zoraptera,[1] while the Psocida are in turn very like the ancestors of the Homoptera (which gave rise to the Hemiptera). The

[1] As has been pointed out in a short paper soon to be published, the wing-veins of the Zoraptera are remarkably similar to those of certain Psocida Thysanoptera and Homoptera.

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Hymenoptera occupy a position somewhat intermediate between the Psocida and Neuroptera, but they are also very closely related to the Coleoptera, and it is very probable that their ancestors were anatomically intermediate between the Zoraptera (with the Isoptera) and the Coleoptera (with the Dermaptera). The Mecoptera (and Trichoptera) are quite closely allied to the Hymenoptera on the one hand, and the Neuroptera on the other, although their closest affinities are with the Neuroptera, such Neuroptera as *Nemoptera* being extremely like the forms giving rise to the Mecoptera and to the Diptera, which were derived from Mecoptera-like forebears. The Trichoptera and Lepidoptera, although related to the Mecoptera also, were probably derived from Neuropteroid ancestors closely resembling the Ithoniidæ (such as *Oliarces*). The Neuroptera themselves are extremely closely related to the Coleoptera, and doubtless arose from ancestors intermediate between the Coleoptera (with the Dermaptera and Embiidina) and the Zorapteron-Isopteron group—in other words, the lines of descent of the Psocidæ, Hymenoptera, Neuroptera and other insects at the base of the stem of the higher forms converge to a point intermediate between the Zorapteron-Isopteron group on the one side, and the Coleopteron-Dermapteron group (with the Embiidina) on the other; so that these groups are of the greatest phylogenetic interest, not only from this fact, but also from their position on either side of the stem forms from which the Orthopteroid insects were likewise developed.

With regard to the grouping of the different insect orders into superorders,[1] there are apparently eight principal superorders in the class Insecta. Of these, the superorders Panprotura and Panthysanura belong in the subclass Apterygota, while the other six belong in the subclass Pterygota. The principal representatives of these superorders are as follows:

Proturoid Superorder (Panprotura)

Protura, Entomobryoida, Sminthuroida, etc.

Thysanuroid Superorder (Panthysanura)

Campodeoida,[2] Lepismatoida, Machiloida, etc.

[1] If it be advisable to restrict the termination "*ptera*" to groups of ordinal rank, the above-mentioned eight superorders might be termed the Poduriformia, Lepismiformia, Ephemeriformia, Perliformia, Phasmiformia, Blattiformia, Psociformia, and Sialiformia.

[2] A study of the anatomical details of *Campodea*, *Projapyx*, *Japyx*, etc., has shown that these insects belong to a single order, and that the division into Rhabdura and Dicellura is of subordinal value only.

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Palæodictyopteroid Superorder (Panpalæodictyoptera)
Protephemerida, Ephemerida, Protodonata, Odonata, Palæodictyoptera, etc.
Plecopteroid Superorder (Panplecoptera)
Haplopteroida, Plecoptera, Hadentomoida, Embiidina, Dermaptera, etc.
Orthopteroid Superorder (Panorthoptera)
Protorthoptera, Grylloblattoida, Phasmoida, Orthoptera, etc.
Isopteroid Superorder (Panisoptera)
Protoblattoida, Blattoida, Mantoida, Isoptera, Zoraptera, etc.
Psocoid Superorder (Panhomoptera)
Psocoida, Mallophaga, Pediculoida, Homoptera, Hemiptera, Thysanoptera (?), etc.
Neuropteroid Superorder (Panneuroptera)
Neuroptera, Hymenoptera, Mecoptera, Protomecoptera, Paramecoptera, Paratrichoptera, Trichoptera, Lepidoptera, Diptera, Siphonaptera, (and possibly Coleoptera and Strepsiptera?).

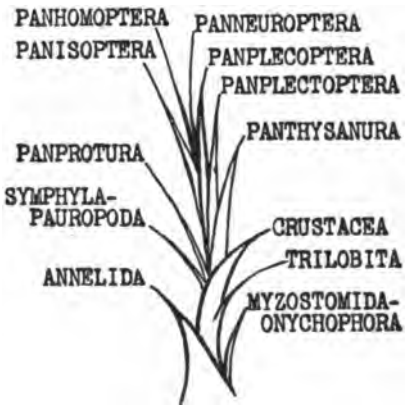

Fig. 6. Grouping of superorders in general scheme.

The interrelationships of these superorders, and their positions in the general scheme, are represented in Fig. 6. As is indicated in the diagram, the Annelida represent as nearly as any known forms, the ancestral types giving rise to the Arthropoda. The Myzostomida-Onychophora group (including the Tardigrada) arose very near the point of origin of the Arthropoda, but these forms are of

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less interest than the Annelida themselves (*e. g.*, *Dujardina*, and other Syllidæ) in the study of Arthropodan development.

The Trilobita and such Crustacea as the Apodidæ (together with the Copepoda) are among the most primitive representatives of the Arthopoda, and the Crustacea in particular furnish us with a series of forms from the lowest type to the ancestors of the "Myropoda" and Insecta, and some of them, such as the Isopoda, Tanaidacea, etc., have paralleled the insectan line of development in the most remarkable fashion, the resemblances in many cases extending even to the minutest details, as I am hoping to show in a series of papers dealing with this subject. The "Myriopoda" apparently branched off from the Crustacean stem from ancestors resembling *Bathynella* and other Anomostraca, and the Insectan line of development arose near the same point. Some of the lower Apterygota carried over in their development many features inherited by such "Myriopoda" as the Symphyla and Pauropoda (as is the case with the Protura, Campodeoida, etc.); but many more Crustacean features were inherited by the forms leading up to winged insects, such as *Machilis*, *Lepisma*, etc., and were carried over in the Ephemerida.

As is shown in the diagram (Fig. 6), the members of the Palæodictyopteroid superorder (*i. e.*, the "Panplectoptera") arose from forms resembling the Panthysanura, or Thysanuroid superorder of Apterygotan insects, and are intermediate between the latter and the Panplecopteroid superorder (with the Panisoptera). The higher insects (*i. e.*, the Psocoid and Neuropteroid superorders) in turn, arose from ancestors intermediate between the Panisoptera and Panplecoptera, although the "roots" of these stems strike downward into the Palæodictyopteroid forms also, as is indicated by the carrying over of certain Palæodictyopteroid features in their lines of descent.

The occurrence of annectent forms intermediate between two or more superorders makes it extremely difficult in some cases, to determine exactly where these forms belong. Thus the Coleoptera might be grouped either with the Neuropteroid insects or with the Plecopteroid insects (Dermaptera, etc.), while it is extremely difficult to determine whether to place the Grylloblattoida with the Isopteroid insects, or with the Orthopteroid insects—or even with the Plecopteroid forms. Similarly, the balance of characters in

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the Isoptera (with the Zoraptera) and Dermaptera is so evenly divided between the Blattoid and Plecopteroid groups that it is only after careful consideration that one can make up his mind where to place them. On the other hand, such strongly aberrant forms as the Thysanoptera and Strepsiptera are also extremely difficult to place, and until more is known of the embryology, internal anatomy, and further anatomical details of these forms than is at present available as evidence for determining their closest affinities, the groupings here proposed must be regarded as purely provisional, and subject to further revision in the light of subsequent investigation. It may be stated, however, that none of the facts thus far brought forward would indicate that the views here proposed are untenable, and a further study of the forms in question has in each case merely served to confirm the correctness of the conclusions concerning the groupings here proposed.

PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB

At the meeting June 8, 1920, Mr. Parker of the U. S. Entomological Laboratory at Arlington, Mass., gave an account of the effect of the hymenopterous egg parasite, *Trichogramma minutum* on the European corn-borer in this country. Last year 28,000 eggs of the corn-borer were examined and 43 per cent. were found parasitized by Trichogramma. Collecting notes were read by several members and notice was given of expected appearance of the periodical Cicada at several localities in Massachusetts, Connecticut and Rhode Island. It was voted to hold the next meeting on the second Tuesday in September.

At the meeting of September 14, 1920, Mr. C. W. Johnson read a paper on the New England brood of the periodical Cicada and its failure to appear this year. Mr. Johnson had visited the place near the Logue reservoir in Washington, R. I., where the insect was found in large numbers in 1903 as described by A. S. Packard in PSYCHE for December of that year, but found none. He read a letter from Mr. George Dimmock who visited the place at Suffield, Conn., where he had collected the Cicada in 1869 and found none at this time. Inquiries were made and letters received from the following places where the insect was seen in 1903 without any

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appearance of them this year: Freetown, Mass., near Fall River, Russell, Mass., Tolland, Conn., State Line near Monson, Mass. Mr. Johnson concludes that the brood has become extinct.

Mr. J. H. Emerton spoke of a visit to the summit of Mt. Washington during the first week of July. Two new species of spiders were found under small stones at about 5,000 feet elevation.

Mr. L. W. Swett said that he and Mr. S. E. Cassino had visited Mt. Washington as early as May 28 and again in August and found many rare lepidoptera.

Mr. C. V. Blackburn showed a gynandromorph of the Gypsy Moth with the right side male and left side female, each half with the usual size and colors of its sex.

At the meeting of October 12, 1920, R. Heber Howe, Jr., mentioned the finding of eight species of Dragon-flies new to New England and showed maps giving their known distribution in North America.

Prof. W. M. Wheeler gave an account of his visit last summer to the station of the New York Zoölogical Society 50 miles up the Essequibo River in the forests of British Guiana. One of the great sources of entomological interest was a leguminous tree, Tachigalia, with long pinnate leaves in the hollow petioles of which live great numbers of Coccids, the excretions of which attract swarms of ants and other insects, including a social beetle, and these insects draw around them dipterous and hymenopterous parasites of many kinds. As these trees become larger and their wood harder they become the homes of great colonies of ants.

Dr. Wheeler found one morning a decayed tree filled with a great colony of the ant *Eciton burchelli*. As they were driven out by smoke, clusters of them held together around large cocoons containing male pupæ. The colony finally settled in two large masses in each of which was a freshly matured female. Specimens of the ants were exhibited.

Collecting notes were read and discussed by several members.

Mr. A. F. Burgess, Secretary of the Association of Economic Entomologists, said that enough copies of the Record of Economic Entomology to 1915 had been sold to pay the expense of printing and he was now soliciting subscriptions to a supplementary volume bringing the record up to 1920, the manuscript of which was ready to publish.

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BOOK REVIEWS.

THE ORTHOPTERA OF NORTHEASTERN AMERICA, by W. S. Blatchley. The Nature Publishing Co., Indianapolis, Ind., 1920.

In this volume Professor Blatchley has added another to his valuable series of entomological treatises, useful alike to the specialist and the general student of entomology, and one which was much needed, so many scattered descriptions having appeared in recent years at the hands of a number of authors that their collation and correlation by a special student of the order was greatly to be desired. Professor Blatchley's residence in Indiana and Florida and his long familiarity with the group enabled him to bring to the task an equipment possessed by few; and his views on the synonymy, etc., of the various forms should accordingly receive the consideration they deserve, even though it is, perhaps, too soon to decide definitely the standing of some of the less known forms.

The notes on songs, habits and distribution naturally constitute the most attractive part of the book to the biologist, but the bibliography and synonymy are equally helpful to the student.

The volume is well illustrated with text cuts, and well printed except for several instances of inversion of cuts, cases apparently of mistaken humor (?) on the part of the printer's devil (or should it read *vice versa?*). So flagrant are these in character that one might truthfully say that Professor Blatchley owes it to his fellow-scientists, having manuscripts to publish, to acquaint them with the name of the firm responsible for such actions.

The book is a very presentable, readable, and useful account of the order as found in eastern North America, indispensable to every student of the orthoptera, the first of its kind in its field, and we bespeak for it the welcome it deserves.

A. P. M.

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For sale, or exchange for entomological items not in my library—American Entomologist, complete; Dyar, List of N. A. Lepidoptera; Redi, Experimenta, circa Generationem Insectorum, 1686; many others.—J. E. Hallinen, Cooperton, Okla.

Wanted: To examine, determine and exchange Cicadellidæ or "Jassidæ" from all parts of North America.—J. G. Sanders and D. M. DeLong, State Capitol, Harrisburg, Pa.

Cochineal Insects: Wish to obtain living specimens of cochineal scales. Will purchase or exchange as may be desired.—C. T. Brues, Bussey Institution, Boston 30, Mass.

Wanted: Species of Rhynchophora from Eastern North America not represented in my collection, in exchange for duplicates from Indiana and Florida. Lists of desiderata and duplicates on application.—W. S. Blatchley, 1530 Park Avenue, Indianapolis, Ind.

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1921

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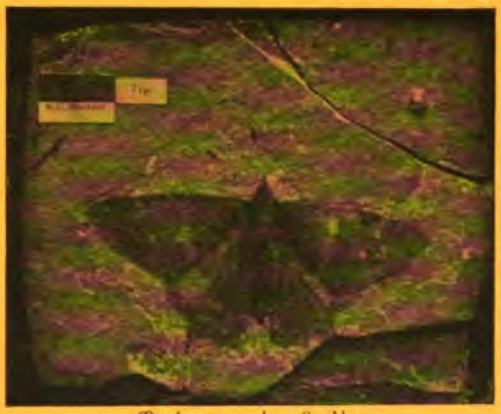

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PSYCHE

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NEW SPECIES OF EMPHYTINAE AND SELANDRIINAE—HYMENOPTERA.

By Alex. D. MacGillivray,
University of Illinois, Urbana, Ill.

The adults of the following new species of Tenthredinidæ were all bred from larvæ. The specimens from New York were collected and bred by Dr. H. Yuasa, and the Maine specimens by the Maine Agricultural Experiment Station at Orono.

Strongylogastroidea depressata sp. nov.

Female. Body black with the following parts whitish: labrum, tegulæ, procoxæ, mesocoxæ, spot on metacoxæ, and trochanters; with the following parts rufous: mandibles, angles of clypeus, distal three or four segments of the antennæ, legs beyond the trochanters except the metatarsi which are fuscous to black, abdominal segments three and four, terga and sterna, and saw-guides in great part; third segment of antennæ distinctly longer than fourth and not as long as fourth and fifth together; clypeus very shallowly emarginate; ocellar basin deep with vertical walls, surrounding median ocellus, extending between antacoriæ; median fovea obscure; surface of ocellar basin and its bounding walls finely punctate; postocellar area polished; mesoscutellum with lateral portions coarsely punctate; saw-guides with dorsal margin concave and ventral margin convex, distal end bluntly rounded; wings hyaline; veins including costa pale, stigma infuscated. Length 7 mm.

Habitat: Orono, Maine. Sub. 39.

This species is similar to *unicincta* Nort. The black collar, the pale femora, and the difference in the saw-guides will separate them.

Emphytus yuasi sp. nov.

Female. Body black with the following parts white: clypeus, labrum, mandibles in great part, tegulæ, collar, ventral half of

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mesopleuræ and extending over mesosternum, coxae, trochanters, femora except distal ends of mesofemora and metafemora, more or less suffused with rufous, tibiæ except narrow band on caudal margin and a ring at the distal end, protarsi and mesotarsi except narrow band on caudal margin, narrow band on proximal end of basitarsi of metatarsi, ventral aspect of abdomen, and caudal tergum except at sides; mesal portion of terga with a yellowish mark, largest on second to fifth, extending along caudal margin; clypeus deeply squarely emarginate; third segment of antennæ distinctly longer than fourth; antennal furrows broadly rounded, indistinct; ocellar area elevated, ocellar basin a rounded furrow; median fovea indistinct; head punctate below lateral ocelli; oblique depression extending from lateral ocelli toward compound eye; mesonotum polished; wings hyaline, costal and proximal spot on stigma yellowish, veins and stigma black; saw-guides convex on dorsal and ventral margins, distal end obliquely rounded. Length 6.5 mm.

Habitat: Ithaca, New York. No. 171-1.

This species is similar to *apertus* Nort., but the difference in the length of the third segment of the antennæ will separate them.

Unitaxonus Gen. nov.

Front wings with the radial and radio-medial cross-veins distinct, free part of subcosta one apparently wanting, free part of second anal vein present, slightly oblique, located some distance nearer the proximal end of the wing than media four plus cubitus one; hind wings with the free part of radius four and the transverse part of media two wanting, the second anal cell petiolate; antennæ with nine segments; clypeus nearly truncate in the female; the basitarsus of each metatarsus about subequal in length to the four following segments. Type, *Unitaxonus repentinus* MacG.

Unitaxonus repentinus sp. nov.

Female. Body black with the following parts rufous; mandibles, femora, tibiæ, protarsi, mesotarsi, and abdominal segments two to four, including terga and sterna; with the following parts whitish: labrum, tegulæ, procoxæ, distal portion of mesocoxæ, and trochanters; antennæ with third segment distinctly longer than fourth; clypeus faintly broadly emarginate, almost truncate; supraclypeal

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area elevated; median fovea broad, shallow, almost obsolete; ocellar basin oval, not deep; head including postocellar area polished; median and lateral lobes of the mesonotum polished, mesocutellum in part punctate; wings slightly infuscated, stigma and costa yellowish infuscated, veins black; saw-guides with dorsal margin straight, ventral margin convex, converging toward distal end, distal end truncately rounded. Length 7 mm.

Habitat: Ithaca, New York. No. 129-1-2.

The male differs only in having the clypeus more deeply emarginate, limited on each side by slight projections and the bottom of the emargination straight.

Unitaxonus rumicis spec. nov.

Female. Body black with the following parts rufous: labrum, mandibles, distal two-thirds to one-half of coxæ, trochanters, femora, tibiæ, protarsi, mesotarsi, and abdominal segments two to four; third segment of antennæ nearly twice as long as the fourth; clypeus only slightly emarginate; median fovea wanting; ocellar basin oval, deep, surrounding median ocellus, limited at ventral end by a round flat area between antacoriæ; head polished; median and lateral lobes of mesonotum polished; mesopleuræ densely setaceous and finely punctate; wings infuscated, costa pale, veins and stigma black; saw-guides with margins straight and distal end broadly bluntly rounded. Length 8 mm.

Habitat: Ithaca, New York. No. 91-2-1.

The length of the third antennal segment and the shape of the saw-guides will separate this species from *repentinus* MacG. Described from a single specimen in poor condition.

Empria cetaria sp. nov.

Female. Body black with the following parts white: labrum, tegulæ, and legs except proximal two-thirds of coxæ, distal third of metafemora, and distal end of metatibæ; metatarsi infuscated; head polished, densely setaceous, punctate with numerous fine calices; clypeus flat, squarely shallowly emarginate, lateral projecting angles bluntly pointed; ocellar basin a shallow shield-shaped depression including median ocellus; median fovea very minute, slight pit-like depression at ventral end of ocellar basin; antennæ with

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segments four and five subequal, three distinctly longer than four and not as long as four and five together; head with a convex ridge between antennal furrows; ocellar and interocellar furrows obsolete; mesonotum polished, mesoscutellum with caudal half punctured; saw-guides with dorsal margin concave, ventral margin convex, converging toward bluntly rounded distal end; wings hyaline, veins, costa, and stigma brownish. Length 6 mm.

Habitat: Ithaca, New York. No. 119-1-2.

This species is related to *celsa* MacG., from which it can be differentiated by lack of ocellar and interocellar furrows.

Empria cerina sp. nov.

Female. Body black with the following parts white: labrum in part, collar narrowly, tegulæ, distal ends of femora, protibiæ, mesotibiæ, proximal and distal ends of metatibiæ, proximal end broader than distal, protarsi, and proximal portion of mesobasitarsi; clypeus with a fine mesal ridge and tooth, ventral margin narrow, emargination shallow; antennæ with third and fourth segments subequal, short; ocellar basin shallow, extending between antacoriæ and bearing pit-like median fovea and median ocellus, latter bounded by distinct Y-shaped furrow; ocellar and interocellar furrows distinct; antennal furrows interrupted near middle; postocellar area broader than long; median and lateral lobes of mesonotum polished; mesocutellum finely punctate; wings hyaline; veins brownish, costa and stigma infuscated; saw-guides with dorsal margin straight, ventral margin convex, rapidly converging to obliquely, bluntly pointed distal end. Length 6 mm.

Habitat: Ithaca, New York. No. 107-5-2 and 107-3.

This species can be separated from *cauduca* MacG. by the shallow emargination of the clypeus and the form of the median fovea.

Thrinax pullatus sp. nov.

Male. Body black with the following parts rufous: collar narrowly, trochanters, femora, tibiæ, and tarsi except two or three distal segments of the metatarsi; abdominal terga with caudal portion with a narrow linear yellowish or rufous margin; antennae with third and fourth segments subequal; labrum densely setaceous; clypeus broadly, roundly, shallowly emarginate; median

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fovea punctiform; ocellar basin broadly limited by a distinct frontal crest, surrounding the median ocellus; antennal furrows obscure, interrupted near middle of their length; vertical furrows deep, broad, longer than broad; postocellar area with a deep mesal furrow connecting with shallow inconspicuous ocellar furrow; surface of head dull; mesonotum dull, indefinitely punctate or striate; mesoscutellum with distinct furrows on each side, polished on meson; metascutellum polished, impunctuate; mesopleura dull, sparsely sericeous; cerci distinct, short, porrect; caudal margin of caudal sternum rounded; wings hyaline, costa reddish, veins and stigma infuscated. Lenth 8 mm.

Habitat: Ithaca, New York. No. 20-1.

The general appearance of this species, the arrangement of the pale color and the line of the abdominal segments is similar to that of *Strongylogaster politus* Prov. The difference in the coloration of the abdomen will differentiate it from *Thrinax impressatus* Prov.

NEW UNITED STATES ZOOCECIDIA.

By B. W. Wells,
State College, Raleigh, North Carolina.

In the descriptions below, the author has indicated in each case whether the gall is a kataplasma or a prosoplasma. These terms of Küster's pertaining to the lower and higher galls respectively, deserve a prominent place in gall descriptions, for they connote very significant conditions. The writer has pointed out (Botanical Gazette, May, 1921) that these groups have an evolutionary relationship. By "kataplasma" Küster means those indefinite galls whose structure is developed through hyperplasia of embryonic tissue, the end product not becoming in its differentiation, orientation and form of tissues, fundamentally different from the normal plant part; they represent inhibitions of the normal differentiations, the more advanced ones thus approach homogenity. "Prosoplasmas," on the other hand, are definite galls whose structure differs fundamentally from the normal plant part, the tissues

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in their form and orientation characters constituting an aggregation of new qualities.

In presenting these descriptions, it is with the hope that these forms may again be collected and the adult stages of the cecidozoons be obtained.

Not until the descriptions of the adults appear should names be attached to galls; in the present paper the forms have been given a number which can readily be referred to by any future investigator. I should like to here repeat a statement made in an earlier paper: "The custom on the part of some, of applying a specific name to an insect or mite, merely on the basis of the intimately associated gall, is to be deplored."

The familiar "catch-all" generic names have been used in those cases in which the nature of the parasitic organism was determined, viz., "Cecidomyia" for an itonidid form, "Cynips" for a cynipidous form, and "Eriophyes" for a mite gall-maker.

The galls herein described and believed to be heretofore unreported, are arranged on the basis of the plant affected. The plant genera are arranged alphabetically, Gray's Manual being followed in the matter of nomenclature.

Amelanchier

Cecidomyia sp. Cecidium nov. Fig. 1.

1. On *Amelanchier canadensis* (L) Mefic., leaf; prosoplasma, appendicular, diverticulum type; stout balloon-shape with attenuate tip, 3-5 mm. long, 2-3 mm. wide, reddish purple, surface, however, with bloom which gives it a bluish tinge; galls commonly found in groups of two, on under side of leaf, each gall tilted out of the perpendicular position; opening in leaf-blade on side opposite the gall, minute, slit-like with definitely raised lips; cavity small in the broader, distal part connected with opening by a relatively narrow canal, walls thick with rather prominent veins; not common, Cedar Point, O. Types in author's collection.

Cecidomyia sp. Cecidium nov. Fig. 2.

2. On intervenal areas of leaf of *Amelanchier canadensis* (L) Medic. (service berry); prosoplasma, sub-ovid, laterally flattened, the sides paralleling the secondary veins, extending from both sides of the leaf, long axis perpendicular to the blade, 2-3 mm. long,

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upper side rounded, yellow or red, lower side truncate with slit-like opening, yellowish, surface smooth; monothalamous, chamber in upper half of gall connected with slit-like opening by narrow, flattened canal, walls firm; locally abundant, Hocking Co., Ohio, Cedar Point, Ohio. Types in collection of author.

Amorpha.

Cecidomyia sp. Cecidium nov. Fig. 3.

3. On *Amorpha canescens* Pursh, leaf rachis, leaflet either side or flower stalks; prosoplasma, up-walled type; cone-shaped with truncate ends, more or less curved, when on leaflet, base projects as a rounded prominence beyond the blade, 4-12 mm. long, larger when on leaf or floral axes, galls of leaflets exposed to light distinctly red in color, pubescence similar to that of normal plant; chamber shape conforms to that of gall; fairly common, numerous on particular plants, Manhattan, Kan. Types in collection of writer.

Cecidomyia sp. Cecidium nov. Fig. 4.

4. On *Amorpha canescens* Pursch, leaflet; kataplasma, edge-roll type; revolute leaf edge, yellow, 3-5 mm. long, pubescent like normal leaf; fairly common, Manhattan, Kan. Types in collection of writer.

Albizzia.

Coccid sp. Cecidium nov. Fig. 5.

5. On *Albizzia julibrissin* Durazzini, stem surface; kataplasma; simple, circular elevations with depression in center containing coccid, 5.8 mm. dia., lighter in color than surrounding bark, the color of the new hyperplastic tissue which has become exposed; locally common, Raleigh, N. C. Types in collection of the writer.

The above gall may be found on stems of widely varying age. It may be formed on trunks measuring 7-8 cm. dia. The figure is from a stem measuring 3 cm. in dia. and which is 7 years old.

Azalea.

Coccid sp. Cecidium nov. Fig. 6.

6. On *Azalea nudiflora* (L) Torr., stem surface; kataplasma; simple diamond-shaped elevations with rounded corners with depression in center containing coccid, 1 cm. long, elevation about

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2 mm. above twig surface. Surface of raised portion coarsely striate due to splitting of original epidermis; abundant locally, Raleigh, N. C. Types in collection of the writer.

Castanea.

Cecidomyia sp. Cecidium nov. Fig. 7.

7. On *Castanea pumila* (L) Mill., leaf; prosoplasma, asymmetric up-walled type; arises from vein (under side) and curls in toward leaf forming pocket, blade above gall pressed upward forming umbo as seen from above, gall flattened parallel to blade, 4 mm. long, 2 mm. wide, surface same as leaf or lighter; chamber ovoid, wall thick especially on vein side; abundant on certain trees, Carolina Beach, N. C. Types in collection of writer.

This gall is of especial interest for the reason that it is a striking asymmetric variant of the up-walled type. It appears to be produced by an upgrowth from the vein which instead of being equal on all sides of the larva is distinctly one-sided, resulting in the strongly curled or revolute structure observed. I know of no other gall like it in this respect; it constitutes a new fundamental gall type.

A relatively large itonidid larva was constantly present in the galls.

Chenopodium.

Cecidozoon undetermined. Cecidium nov. Fig. 8.

8. On Chenopolium ambrosiodes var. anthelminticum (L) Gray, stem gall; kataplasma; simple fusiform enlargement of the stem, 1–1.5 cm. long, color and texture same as stem, single chamber elongate, relatively large with irregularly pitted walls; not common, Toledo, O. Types in the collection of the writer.

Cunila.

Cecidomyia sp. (?) Cecidium nov. Fig. 9.

9. On *Cunila origanooides* (L) Britt. (Dittany), bud gall, on ends of aborted upper branches; prosoplasma, up-walled type; subspherical, tipped with short point, 2–3.5 mm. dia., green at first early becoming bluish-purple, surface glandular same as leaves, sessile on branch end, invested below by an involucre of a few inconspicuous, foliaceous bracts; chamber large, same shape as gall,

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wall thin, similar to leaf in texture though slightly thicker than leaf; few on any one plant. Martin Co., Ind. Types in collectiou of writer.

This gall was collected by Mr. Chas. C. Deam, to whom I am indebted for its study.

Gleditsia.

Cecidomyia sp. Cecidium nov. Fig. 10.

10. On *Gleditsia triacanthos* L., leaf rachis; kataplasma; simple elongate swelling of leaf rachis, commonly the secondary axes, 5-10 mm. long, about 1 mm. dia., surface same as normal rachis; monothalamous, the chamber a mere capillary tube; not uncommon, Toledo, O. Types in collection of writer.

Grindelia.

Cecidomyia sp. Cecidium nov. Fig. 11.

11. On *Grindelia lanceolata* Nutt. (Rosin weed), a modification of the floral head; kataplasma, rosette type; a mass of overlapping involucral bracts (each external bract much thicker than normal ones), the whole assuming an ovoid shape, 2.4–3.5 cm. long; single chamber at center surrounded by much reduced bracts, elongate-ovoid; one or few galls on single plant, infrequent; Fayetteville, Ark. Types in collection of writer.

The characteristic salmon-covered larva of the Itonididæ with breast-plate was found in the galls.

Fig. 11, left, shows a normal head and a galled one; right, section of affected head.

Grindelia.

Cecidomyia sp. Cecidium nov. Fig. 12.

12. On *Grindelia squarrosa* (Pursh) Dunal, bud gall; kataplasma; sub-globose with attenuate tip or tips representing aborted leaf elements, 5-8 mm. dia., green, very prominent in axils of normal leaves, 1-4 chambers, each elliptical in outline, walls thick of firm, fleshy texture; not common, Manhattan, Kan. Types in the collection of writer.

Hedeoma.

Cecidomyia sp. (?) · Cecidium nov. Fig. 13.

13. On *Hedeoma pulegioides* (L) Pers. (Pennyroyal), a simple

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inflated calyx; kataplasma, organoid type; calyx slightly inflated to sub-spherical form, 2 mm. dia., segments but slightly differentiated if at all, yellowish, normal nutlets undeveloped. Rather abundant on specimens of pennyroyal seen. Jeffersonville, Ind. 1-4 larvæ present in galls.

Collected by Mr. Chas. C. Deam.

Fig. 13, upper, normal calyx; lower, affected calyx.

Heterotheca.

Lepidopteron. Cecidium nov. Fig. 14.

14. On *Heterotheca subaxillaris* (Lam.) Britton and Rusby, stem gall; kataplasma; simple fusiform enlargement of stem, 3.5–5 cm. long, about 1 cm. wide, epidermis split into elongate diamond-shaped areas concolorous with stem, chamber relatively large, shape of gall. Not uncommon, Arlington, Texas. Types in collection of writer.

Ilex.

Cecidomyia sp. Cecidium nov. Fig. 15.

15. On *Ilex vomitoria* Ait., leaf; kataplasma, leaf-fold type; a simple fold of leaf along midvein with accompanying thickening of part involved, commonly affecting the terminal leaves in which the largest part of the blade is involved, 3-5 mm. long, 2-3 mm. wide, surface same as normal leaf except color is lighter or where exposed to sun, red tinged; Carolina Beach, N. C. (Fort Fisher) occurring on shrubs exposed to ocean; rather common. Types in collection of writer.

Lepidium.

Cecidozoon undetermined. Cecidium nov. Fig. 16.

16. On *Lepidium virginicum* L., stem or root surface; kataplasma; simple, sub-globular, sessile, at stem base or crown of root. .5–1 mm. dia., yellow, smooth; in each gall a yellow-ovoid egg was found (.2 x .15 mm.) enclosed by the homogenous, pith-like tissues of the gall; Arkansas. Types in collection of writer.

The fact that this gall has developed in the presence of the unhatched egg indicates the stimulus to have originated with the adult cecidozoon at the time of oviposition. I was unable to rear the adults and am unable to assign the gall to any group.

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I am indebted to Mr. M. R. Ensign for this material.

Fig. 16, left, galls on stem base; right, included egg.

Liatris.

Cecidomyia sp. Cecidium nov. Fig. 17.

17. On *Liatris punctata* Hook., bud gall; kataplasma; subglobular, consisting of a mass of swollen and fused leaves, the ends of some of them projecting distally from the gall, 5-10 mm. dia., 3-5 elongate larval chambers; not common, Manhattan, Kan. Types in collection of writer.

Lobelia.

Cecidomyia sp. Cecidium nov. Fig. 18.

18. On *Lobelia puberula* Michx., stem swelling; kataplasma; simple rather inconspicuous enlargement of stem, variable in length, the maximum being about 10 cm., width varying from 4-5 mm., surface same as normal stem except for presence of a few longitudinal fissures in the epidermis exposing the cortical layer; internally the pith tissue contains a more or less broken, narrow cavity occupied by the larvae which are distributed in a linear series; all tissues of the stem are about equally involved in the hyperplasia. Not uncommon, Raleigh, N. C. Types in collection of the writer.

I am indebted to Mr. I. V. Shunk for the original collection of this material.

Parthenium.

Eriophyes sp. Cecidium nov. Fig. 19.

19. On *Parthenium integrifolium* L.; leaf-blade gall; kataplasma, diverticulum type with trichomes (erineum); extremely variable evaginations projecting either side of the leaf, the smaller ones covered internally and exteriorly with a heavy layer of tomentum made up of slender, twisted, multicellular trichomes, larger pouches often nearly smooth on exterior. Rather infrequent, West Raleigh, N. C. Types in author's collection.

Fig. 19, left, affected leaf; right, two trichomes.

Persea.

Aphid sp. Cecidium nov. Fig. 20.

20. On *Persea Borbonia* (L) Spreng., leaf; kataplasma, leaf

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edge-roll type; rather definite local inrollings (upper side) of leaf edge, wall markedly thicker than ordinary leaf, forming definite cavity, galls variable in size, .4–2 cm. long, 3–10 mm. wide, surface smooth, often glaucous, lighter in color than leaf when young, changing to red and finally black when old; abundant, Wrightsville, N. C. Types in author's collection.

Pinus.

Eriophyes sp. Cecidium nov. Fig. 21.

21. On *Pinus echinata* Mill., bud; kataplasma; rosette type; excessive proliferation of stem buds, the leaves either remain massed in the bud condition or develop in a semi-aborted fashion, forming a dense cluster or rosette; intermediate states are of course found; not uncommon, S. E. Ohio, North Carolina. Types in author's collection.

For the first observed material of this form I am indebted to Mr. J. S. Houser of the Ohio Ex. Station. I have repeatedly collected it in North Carolina. In all collections the mites were demonstrated.

Polygonum.

Coleopteron sp. (?) Cecidium nov. Fig. 22.

22. On *Polygonum aviculare* L. (Bird's Knot Weed), internodal swelling; ovoid enlargement of internode (sometimes involving two internodes), 8-13 mm. long, 3-7 mm. wide, green to reddish brown, surface more coarsely striate than normal stem; chamber large, same shape as gall, walls firm; few on plant; Mt. Vernon, Ind. Types in collection of writer.

This gall was collected by Mr. Chas. C. Deam of Bluffton, Ind. Larvæ taken from the galls were tentatively determined as coleopterous by Professor Z. P. Metcalf of N. C. State College. It is to be hoped this insect may soon be successfully reared, for, if it is coleopterous, it will be an interesting addition to the very limited group of gall-making beetles known in America.

Polygonum.

Cecidozoon undetermined. Cecidium nov. Fig. 23.

23. On *Polygonum lapathifolium L.*, leaf edge-roll gall; kataplasma; variable in size and shape, often involving leaf to midrib,

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roll very tight, yellow in color, contrasting strongly with normal part of leaf. Common locally, Raleigh, N. C. Types in collection of writer.

In the central region of these galls there constantly occurred a white larva without breast-plate. Whether or not these were merely secondary forms in a possible aphid gall was not determined.

Quercus.

Cynips sp. (?) Cecidium nov. Fig. 24.

24. On *Quercus Muhlenbergii* Engelm., leaf; prosoplasma; broadly crescentic or banana-shaped, attached laterally and sessile on under side of leaf, tips attenuate, 2.5 mm. long, 1 mm. wide, smooth, light green, cavity large ovoid not extending into tips, wall thin; not common, Manhattan, Kan. One specimen, type in collection of writer.

Houard describes a similar gall formed on *Q. toza* of Europe by *Trigonospis bruneicornis* Tav. This form differs, however, in bearing long, straggling hairs.

Cynips sp. Cecidium nov. Fig. 25.

25. On *Quercus stellata* Wang., terminal twig swelling; kataprosoplasma; broadly clavate to ovate, 1-2 cm. long, surface similar to normal twig, bud-bearing, monothalamous with false chamber occurring distal to larval cell and opening exteriorly by constricted orifice, false chamber widest near proximal end, lined with thin layer of hard tissue, larval cell ovoid embedded in woody tissue which consitutes the bulk of the gall; not common, Arlington, Tex. Types in the collection of writer.

Amphibolips sp. (?) Cecidium nov. Fig. 26.

26. On *Quercus marylandica* Muench. at node (originates from bud meristem); prosoplasma, radiate-fiber type; balloon-shaped, 1.5–2.25 cm., long axis, green at first, turning yellow when old, not spotted, smooth; larval chamber connected to peripheral zone by relatively few coarse fibers, outer zone or wall very thick (2-3 mm.) and of pith-like consistency, not shrinking when old; fairly common, Arlington, Tex. Types in collection of writer.

The above is comewhat similar to Amphibolips cooki Gillette. It differs in the absence of the red spots, has a thicker wall, is

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never distally nippled and does not shrivel upon drying. The galls remain on the trees for some time after the leaves have fallen and thus are readily observed in the winter.

Cynips sp. Cecidium nov. Fig. 27.

27. On *Quercus stellata* Wang., leaf petiole; prosoplasma; clustered, appendicular; single galls broadly fusiform, angular below through mutual compression, distally round-conic, 4-7 mm. long, 3-5 mm. wide, reddish brown, puberulent; larval chamber in fall minute, .25 mm. dia., walls correspondingly thick, firm, fleshy, outer half more deeply colored (tannin bearing) than inner half; not uncommon, Arlington, Tex. Types in collection of writer.

These galls are most commonly found on the petiole bases of the terminal leaves, where they occur in such masses as to give a striking aspect to the branch end. They dehisce from the trees in late fall, the larva completing its development through the winter and spring.

Rhus.

Eriophyes sp. Cecidium nov. Fig. 28.

28. On *Rhus canadensis* Marsh, leaf; kata-prosoplasma, diverticulum type; irregularly rounded pocket gall, appendicular, under side, 4-6 mm. dia., green to red, on upper side marked by conic depression filled with trichomes; chamber highly branched, opening into depression, trichomes not abundant within; not uncommon, Manhattan, Kans. Types in writer's collection.

Felt[1] mentions a "cylindric pouch gall" on *R. trilobata* (*canadensis*) from Utah. I have collected this narrow, fusiform type in Kansas. It is sharply and constantly different from the above.

[1] Felt, E. P. Key to Am. Insect Galls. N. Y. State Mus. Bull. 200. 1918.

Solanum.

Cecidozoon undetermined. Cecidium nov. Fig. 29.

29. On *Solanum nigrum* (L.) bud gall; kataplasma, gall consists merely of two highly distorted leaves with their incurled edges tightly appressed, forming a large cavity within. The principal veins are not contorted, this condition being confined to the smaller veins and intervenal tissues which have through slight hyperplasia and hypertrophy grown beyond the normal limits of the principal

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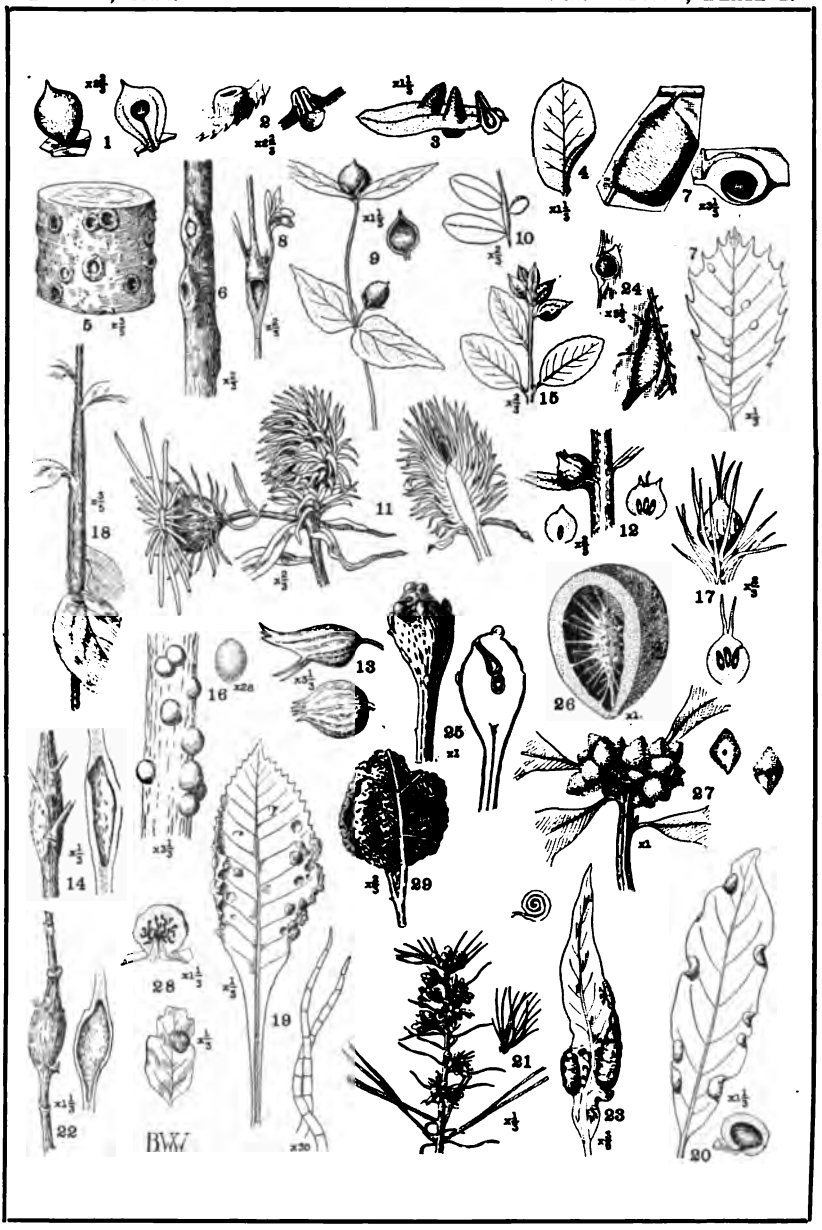

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veins. Infrequent; Fayetteville, Ark. Types in collection of writer.

This curious, primitive gall is evidently formed as follows: The larvæ get into the apical region of the developing stem where they are able to interfere with the normal growth of two very young but definitely formed leaves; the embryonic leaves associated with the apical growing point are suppressed and may be observed in the gall as a compact mass of tissue filling the space between the petioles of the leaves involved in the gall proper.

One or two empty pupa cases of the web type were found in the galls.

Tilia.

Cecidozoon undetermined. Cecidium nov.

30. On *Tilia americana* L., leaf; kataplasma; highly irregular wrinkle and distortion of leaf brought about through inhibition of growth of intervenal tissue; the veins become greatly looped and twisted; not common, Cedar Point, O. Types in the collection of writer.

Within the folds of the distorted leaves were found numerous small white larvæ which apparently were the cause of the galled condition; no evidence whatever of the previous presence of aphids was found.

A NEW ABERRANT FORM OF *VANESSA VIRGINIENSIS* DRURY (HUNTERA FABR.).

By Chas. L. Fox.

The museum of the California Academy of Sciences contains an apparently undescribed variety of *Vanessa virginiensis,* which Mr. E. P. Van Duzee, the curator, has turned over to the writer for description.

Vanessa virginiensis var. *ahwashtee* var. nov.

Upper side. Expanse 43 mm. Primaries: Colors as in typical specimens; fulvous, costal margin, apex and broad outer margin

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of posterior half blackish; base shaded with olive-brown; apical area marked nearly as in the typical form except that the submarginal line is broader and more suffused; posterior half showing an absence of the black bars found in typical *virginiensis* except for a slight trace in the cubitus$_2$ cell near a submarginal white spot usually found in the typical form. Secondaries: Ground color as in primaries; submarginal row of blue eyelike spots represented by a row of small indistinct white blotches which run into a suffusion of white toward the anterior margin; exteriorly without the submarginal black line found in typical *virginiensis;* fringes as in typical form.

Under side. Primaries: ground color whitish with the olive-brown markings of *virginiensis* much reduced; disk pale apricot-orange, pink in typical form, showing a white spot exteriorly and wanting the black bars of the typical form; base with a double black mark; costa with two black bars, as in *virginiensis.* Secondaries: ground color nearly white; a basal band and two bars on the cell approximate anteriorly, one medial, the other apical, blackish, veined with white; anal area delicately shaded with blackish scales; submarginal eyelike spots characteristic of *virginiensis* much reduced, the anterior almost obliterated; subapical black line heavier than in typical forms; other markings found in *virginiensis* absent.

Described from one male taken by Mr. J. A. Kusche in Golden Gate Park, San Francisco, California, November 11, 1911. Type in collection of the California Academy of Sciences. Named for the Ahwashtee tribe of Indians formerly inhabiting the peninsula of San Francisco.

This variation of *V. virginiensis* corresponds with the form *muelleri* of *Vanessa caryæ* in the markings of the upper surface, while beneath, by its white color, it approaches *Vanessa cardui elymi* Ramb.[1] In the type specimen there is a slight folding of the primaries making the outer margin appear to be too deeply notched below the apex.

[1] This form is quite distinct from var. fulva Dodge and from the aberration mentioned by Mr. H. M. Simms in Entomological News, XXV, p. 33, 1914.

Explanation of Plate II.

Fig. 1. Vanessa virginiensis ahwashtee n. var. Upper side.
Fig. 2. Vanessa virginiensis ahwashtee n. var. Under side.
Fig. 3. Vanessa cardui elymi Ramb.

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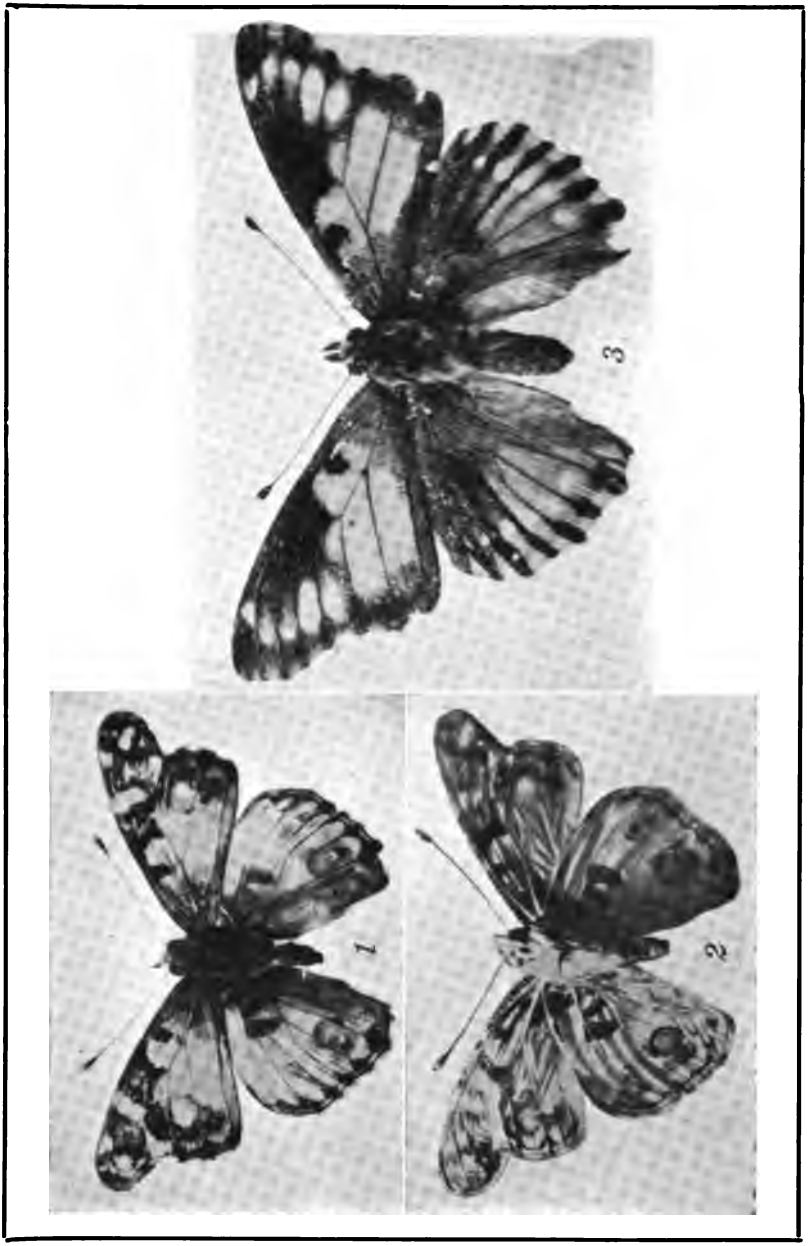

FOX—*Vanessa.*

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NOTES ON THE SOUTH AMERICAN LACTICAS.

By F. C. Bowditch,
Boston, Mass.

In Psyche, volume xx page 127, is given a list of the Lacticas of the Stanford Expedition to Brazil. One of the chief characteristics of the genus as originally laid out, is the transverse groove of the thorax, abruptly terminated by a longitudinal cut; soon, however, forms turned up where this transverse groove was much modified, then were added forms like *thoracica* Jac. where it was almost wanting, and the longitudinal cut only indicated; then *calcarata* Ill. has a well developed spur on the hind tibia (♂ only), then a species appeared with anterior oblique depressions on the thorax (*impressicollis* Jac.), so that the genus as originally planned has been a good deal modified. Among the species undetermined in the above list are:

rubricata Illig., 1 pair, Para.

debilis Har., 1 Madeira Mamore, No. 2219 Thaxter.

trapezophorus Schf., 1 Porto Velho Rio Madeira, No. 2239 Thaxter.

This last species has two foveae on the front and seems rare in collections—though it may be that what seems a fovea is merely the rear of the not uncommon ocular sulcus, covered somewhat by the withdrawal of the head into the thorax.

Lactica brunneipennis sp. nov.

Oblong, medium sized, head, legs and antennæ black; thorax, body below and elytra bright shining reddish-yellow, the latter on either side, with a wide black longitudinal median stripe, starting from the base and extending nearly to the apex, the dark color especially on the disk, being beautifully shaded into the red ground color.

1 (♂) Rio Madeira, Brazil, Mann and Baker, length 4 mm.

Head impunctate on the vertex, and coarsely punctate in the deep ocular sulcus at the rear of the eye, antennæ reaching a little beyond the middle of the elytra, the basal two or three joints more or less red, second joint short, half the length of the third, that

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and the fourth about equal, thorax with nearly straight sides and finely punctuate surface, the usual sulci both deep, straight and well defined, elytra very finely and inconspicuously punctulate, and a very obsolete basal depression; the extreme bases of the femora somewhat rufous.

Lactica limbatus sp. nov.

Ovate, small, pale straw yellow, labrum, antennæ (except the base), vertex and neck, and all the edges of the elytra (including the basal and sutural), very dark reddish, piceous black.

♂ and ♀ Porto Velho Rio Madeira, Brabil (Mann and Baker), length 2½–3 mm.

Head finely punctured on the face, very sparsely on vertex, thickly in the ocular sulcus, antennæ 2/3 as long as body, dilute rufous at base, joints 2, 3, 4, increasingly long, thorax with nearly straight sides, surface very finely punctulate, transverse sulcus fairly well marked, the cut-off at the ends as usual better defined and deeper, scutellum pitchy, elytra thickly and finely punctuate, without basal depression, the disk of each elytron of a pale straw color forming a regular oblong spot from base to apex, but not in any place attaining the edges; body below and legs uniformly pale. The elytral markings easily distinguish this form.

Lactica bakeri sp. nov.

Small, elongate parallel, anterior face, antennæ, thorax and legs pale flavous, tinged (especially the latter) with rufous, rear of head, neck and elytra dark violet, body below greenish-black.

5 examples, Porto Velho, Rio Madeira, Brazil (Mann and Beker), length 2¾–3½ mm.

Mouth parts, and antennæ exteriorly, darkened with rufous, vertex with scattered punctures, sulcus of eye more thickly punctate; antennæ reaching a little below the middle of elytra, joints rather stout and flattened, the apex of each joint with stiff hairs, thorax with slightly rounded sides, a few fine punctures on the disk, usual sulci, prominent, deep and straight, elytra parallel, without basal depression sparsely punctulate. The Mexican species *hidalgoensis* Jac. has the same coloration of the elytra but has the head and body below flavous.

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Lactica spinifer sp. nov.

Stout, like *calcarata* Ill. or *thoracica* Jac. entirely flavous with black eyes (antennæ except first joint missing), hind tibia with a stout spur-like process (like *calcarata*) placed a trifle behind the middle on the inside.

1 example Chancomayo Thamm (first Jac. coll.), length 4 mm.

Head with a small median fovea, and a few punctures on the front and vertex, thorax sparsely, finely punctulate, sides nearly straight, basal sulcus only moderately deep, the lateral deeply foveate; elytra smooth, polished, sparsely, finely punctulate and with a slight basal depression.

The tibial spur easily distinguishes this form.

In Ann. de Belg. 1893, Mr. Jacoby describes *Lactica thoracica*, a Bolivian form, as having the thorax "without any basal sulcus, the lateral grooves just indicated." My specimen came from Cachabe; it is the best example of the absence of the basal sulcus. Another form with the same characteristic is

Lactica plagiata sp. nov.

Ovate, convex, flavous, palpi, antennæ, legs and breast pitchy black, elytra with a large common blue-black spot from the base to below the middle, leaving a narrow strip of the margin flavous, the rear edge of the spot straight.

3 examples, 2 ♂ 1 ♀, Cachabè l. c. (Rosenberg), length 4-5 mm.

Head with well marked carina between the antennæ, front smooth, except for a few punctures, antennæ reaching below the middle of the elytra, second joint small, the first two joints somewhat testaceous below, thorax with straight sides, smooth and shining above, with a few minute punctures, the basal sulcus barely indicated (it might be called absent), the lateral grooves slightly indented; elytra smooth, convex, lightly punctulate, thickly on the yellow area at the tip. In what I consider the ♀ the hind legs are much more strongly developed than in the ♂ and the apex of the hind tibia is broadened and flattened on the inside. The thoracic structure is almost identical with that of *thoracica* Jac.

Sellata Baly is a well known form, widely distributed in Brazil. A species much resembling it superficially I separate as

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Lactica dilatipes sp. nov.

Small, oblong, light straw- yellow, antennæ, except the base, most of the tibæ and tarsi and a common triangular spot on the base of the elytra, dark piceous, hind tibia of ♂ abruptly dilated, inside, near the tip (like some species of Colaspis).

5 ♂ 2♀, Salinas Beni R. (Stuart), length 3½–4 mm.

Head with a broad, smooth front, with a few fine punctures, antennæ relatively stout, reaching the middle of the elytra, second joint nearly equal to the third, thorax with nearly straight sides very finely punctulate, sulci well marked, especially the lateral; elytra, smooth, shining, very minutely punctulate, basal depression slight, the dark spot does not cover the scutel, but touches the base in either side, running round under the shoulder, and a straight line across the middle; distinguished from *sellata* by the light legs and dilated ♂ tibia; the punctuation of the ♀ is stronger than the ♂.

Lactica seminigra Jac. P. Z. S. p. 176, is a preoccupied name and should be changed to Rosenbergi. The ♂ hind tibia is distinctly curved and has a large spur-like process on the inside middle, like *calcarata* Ill. In *thoracica* Jac. what I take to be the ♂ has a well marked dilation of the hind tibia close to the tip.

The general shape of the body and the absence or otherwise of the ocular sulcus may be hereafter an aid in the future arrangement or division of the species of this perplexing group.

ON *PARAPERIPATUS LORENTZI* HORST AND OTHER SPECIES OF THE GENUS FROM NEW GUINEA AND CERAM.[1]

By Charles T. Brues.

Mr. Frederick Muir forwarded to me some time ago three specimens of Peripatus collected by Mr. A. F. Pratt in the Arfak Mountains, Dutch New Guinea.

[1] Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 182.

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Up to the present time, six species of Onycophora, all belonging to Paraperipatus have been found in New Guinea and the adjacent islands of Ceram and New Britain. In order of their discovery, they are the following:

P. novæ-britanniæ Willey. 1898. New Britain.

P. ceramensis Muir & Kershaw. 1909. Western Ceram.

P. papuensis A. Sedgwick. 1910. Arfak Mts., Dutch North New Guinea.

P. lorentzi Horst. 1910. Wichmann Mts., South Dutch New Guinea.

P. schultzei Heymous. 1912. German New Guinea.

P. stresemanni Bouvier. 1914. Ceram.

With the exception of *P. schultzei* and its variety *ferrugineus,* these have been considered by Bouvier ('14) in an admirable paper which includes a key to species based on type material of *novæ-britanniæ, papuensis, ceramensis* and *stresemanni. P. lorentzi* is included in his table from Horst's descriptions ('10 and '11), but *P. schultzei* is not mentioned.

An examination of the specimens send by Muir shows that they are not *P. papuensis,* the type locality of which is the Arfak Mountains, from whence the examples before me also have come. They agree rather closely with *P. lorentzi,* originally discovered in the Wichmann Mountains which lie to the south of the region occupied by the Arfak range. In spite of the several differences detailed below, I have been forced to conclude that two species, *papuensis* and *lorentzi* occur in the Arfak Mountains. Whether the two species occupy a different level, cannot be stated, as there is no indication of altitude on the label attached to the present specimens. However, *papuensis* occurs at an altitude of 3,500 feet, and *lorentzi* was originally found at 9,000 feet, so that it is very probable that the two do not overlap in their distribution.

The types of *P. lorentzi* were females with 22 pairs of legs. All three of the present species are also females, each provided with 23 pairs of legs. In the types the transverse body folds are of two types, consisting of broad folds bearing mainly large papillæ, alternating with narrow folds, which are supplied mainly with accessory

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papillæ. There are five or six folds of each kind to a segment, and the narrow ones sometimes divide or may anastomose with the broad ones. In one of the present specimens such an alternation of broad and narrow folds can be seen, but in the others, and particularly in pieces of integument removed from the body and mounted in balsam under a cover-slip, it is seen that the secondary folds are frequently as broad as the primary ones and that they show much irregularity, division and anastomosis. The middle creeping pad of the legs in the types is twice as broad as the first or the third pad, and in the present examples it varies from one and one-half times the width of the first or third. The nephridial tubercle of the fourth and fifth pairs of legs divides the third creeping pad completely in the type and also in the present specimens, although in one individual these tubercles are abnormally small and do not divide the pad.

Aside from these differences, there seem to be no distinguishing features, and it would seem that two distinct forms cannot be distinguished. It is interesting to note that the specimens at hand approach *P. stresemanni* Bouvier from Ceram in having 23 pairs of legs (23-24 in *stresemanni* and 22 in the typical *lorentzi*) and that the width of the second creeping pad on the leg varies from the size given for *lorentzi* to that given for *stresemanni*.

In the case of the Papuan species, as more are being made known, it is evident that the same difficulties are to be encountered in differentiating species as have already become apparent among the American Onycophora.

While it is apparent that *P. lorentzi* in the Arfak Mountain region approaches the Ceramese *P. stresemanni* in the characters mentioned, it seems improbable that the two species are not distinct, although it is evident that they approach one another very closely.

As no photographs of the integument of *P. lorentzi* have been published, I have prepared some from the finely preserved specimens forwarded by Mr. Muir.

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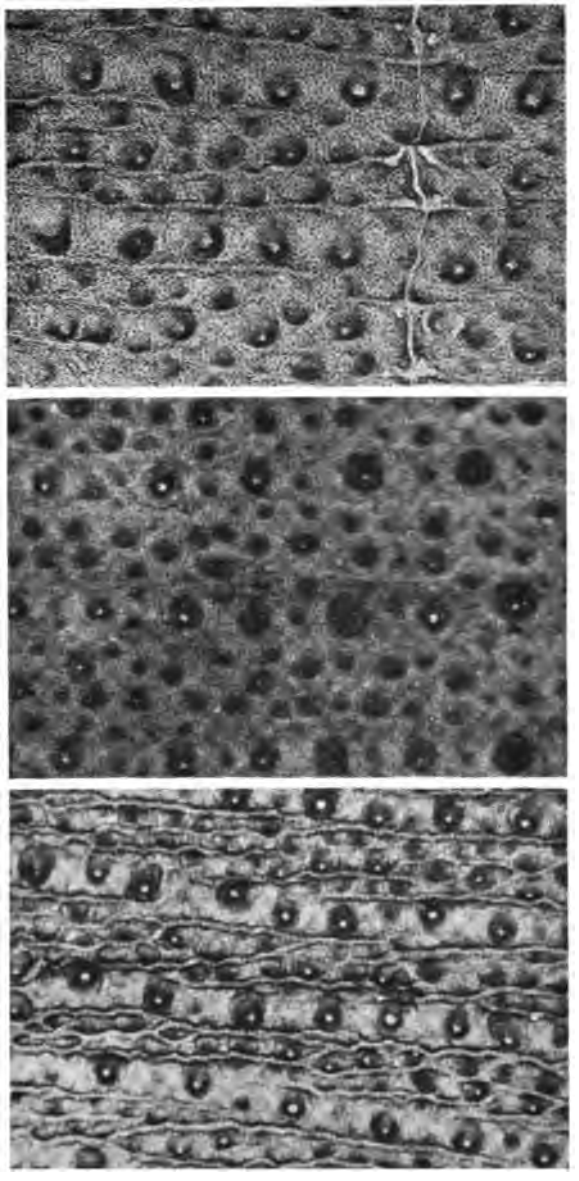

BRUES—*Paraperipatus lorentzi.*

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A NEW GENUS OF TERMITE GUEST FROM FIJI.

By Wm. M. Mann,

Bureau of Entomology, Washington, D. C.

The beetle described below, was collected by the writer on several different islands in Fiji, where individuals occur, one or two to a colony, with a termite (Nasutitermes sp.) common throughout the group and found in dead wood. They were running among the host where the latter were gathered thickest, in a manner common to many species of termitophiles, and similar in habits and behavior to our southern species, *Trichopsenius depressus* Lec.

Coleoptera, Staphylinidæ, Aleocharini.

Lauella gen nov.

Male. (Near Perinthus Casey.) Small, moderately slender. Head, small, not constricted at base, broader than long, sides and occiput convex, vertex flattened. Eyes occupying less than half sides of head, glabrous. Antennæ inserted in rather large and shallow foveæ near interior margin of eye; 11-jointed; first joint three times as long as the third, remaining joints sub-equal in length; joints 3-7 cylindrical, 8-11 compressed, the apical more strongly so than the others. Clypeus submembranous, anterior margin straight. Gula subcampanulate. Labrum twice as long as broad, the anterior border strongly, broadly and triangularly excised at the middle. Mandibles acute at the apex. Submentum and mentum not distinctly divided, together large and sub-quadrangular, with the outer angles rounded. Ligula small, strongly excised apically; paraglossæ not visible. Labial palp thick basally; second joint half as broad as the basal; apical joint less than half as broad as the second. Maxillary palp 4-jointed, basal joint short, second and third joints subequal, the apical slender and much shorter than the third. Pronotum broader than long and a little broader behind than in front, sides strongly convex, anterior and posterior angles evenly rounded and not at all projecting. Elytra strongly transverse, nearly as broad and about two-thirds as long as pronotum, sides inflexed as in pronotum. Metasternum broad, episterna narrow; coxæ contiguous. Abdomen narrower at base

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than elytra, rather slender and tapering; with six segments visible from above, the first four strongly margined. Legs short and broad; femora and tibiæ rather strongly compressed; femora with short tibial grooves; tibiæ rather broad, tarsi long and slender, 4-jointed on all the legs; claws small.

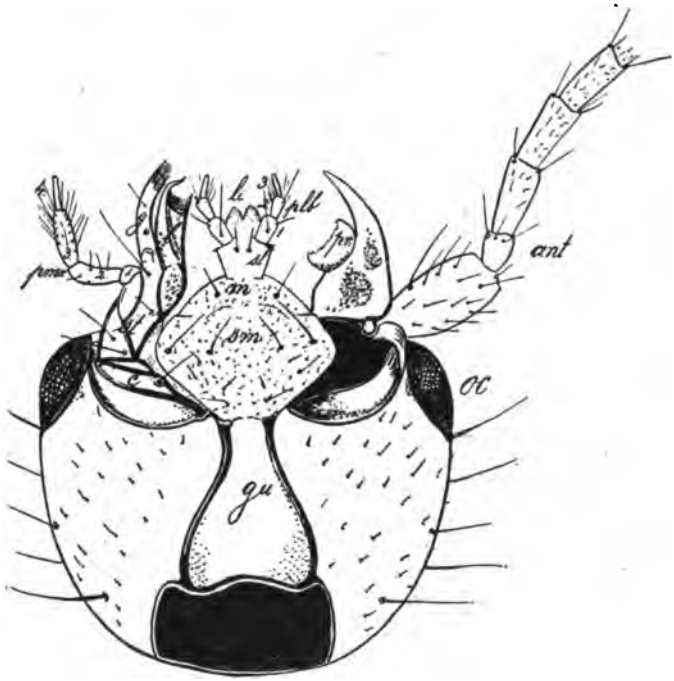

Fig. 1. Head of *Lauella vitiensis* sp. nov.

ant, antennæ; c, cardo; g, galea; gu, gula; l, lacinia; li, ligula; m, anterior part of mentum (fulcrum); oc, eye; plb, labial palpus; pmx, maxillary palpus; pr, prostheca; sl, labial stipes; sm, posterior part of mentum (sub-mentum).

This genus is near *Perinthus* Casey, of which several species, all of termitophilous habit, are known from tropical America. *Lauella* is distinct in having the antennæ more robust, cylindrical at base, and with only the last four joints flattened (much less strongly than in any species of Perinthus), the eyes are not setose and the anterior border of the labrum is very strongly excised at middle. The legs of Perinthus are much less compressed.

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In the male of Lauella the last dorsal segment is broadly and triangularly impressed. In the female seven abdominal segments are visible from above.

Genotype.—*Lauella vitiensis* sp. nov.

Lauella vitiensis sp. nov.

Length 2.50–2.75 mm. (Fig. 1.)

Dark brown, border of abdomen and appendages paler. Head, pronotum and elytra strongly shining, abdomen moderately so. Head, thorax and elytra sparsely and finely punctate; hairs widely separated, long and erect. Abdomen above densely, though superficially punctate; with a covering of fine, short and silky recumbent hairs, most sparse on the dorsum, and a series of long hairs which are suberect on the margins and nearly recumbent on the middle of dorsum.

Head less than half as broad as pronotum. Pronotum about one and one-half times as broad as long, broadest behind, sides little convex. Elytra together twice as broad as long, broadest in front, sides nearly straight, posterior border straight. Abdomen gradually tapering, a little longer than the anterior part of the body.

Described from several specimens taken at Vunisea, Kadavu (type locality); Waquava and Tuvuca, in the Fiji Islands.

The accompanying drawing of the under side of the head and the terminology of the same were kindly prepared by Dr. A. Böving.

NEW DIPTERA FROM TEXAS AND MEXICO.

By Charles W. Johnson,
Boston Society of Natural History.

Lepidostola perpolita sp. nov.

Male. Black, face shining, nearly perpendicular, with a slight middle convexity, sides of the face depressed, the depressions and orbits yellowish pruinose, inferior orbit yellow, frontal triangle shining, the upper angle yellow, in a certain light, a narrow orbital line is seen, expanding and forming a spot on each side, narrowly

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separated from the facial depression, vertical triangle prominent, projecting far above the eyes, occiput shining, antennæ yellow, longer than the face, the first joint longer than the first and second together. Thorax black, with a wide band of bright yellow scale-like tomentum between the shining humeri, a wide arcuate band of the same yellow tomentum in front of the scutellum, between the two bands some scattering yellow scales, pleura and scutellum shining, the latter very prominent, conical and slightly pubescent. Abdomen shining, the first and second segments thinly covered with yellowish hairs. Legs black, shining, bases of all the femora and the tarsi (except the last three joints of the front and the last two on the middle and hind tarsi), yellow. Halteres yellow. Wings yellowish hyaline, the veins, stigma and outer third of the wing slightly darker. Squamæ margined with brown, the lower one fringed with long yellow hairs and the upper one with shorter brown hairs. Length 6 mm.

One specimen, Mexico.

Spilomyia texana sp. nov.

Female., Front and face light yellow with a slight brownish facial stripe and a spot on the inferior orbits; vertex and occiput black, and densely pruinose; antennæ yellow. Thorax black, marked with yellow. The humeri fused with large quadrate spots, occupying about two-thirds of the pronotum, leaving a wide black dorsal and transverse band of equal width, the presutural and post-alar callosities yellow, from the latter extend arcuate markings, the ends of which are separated at the suture by the width of the dorsal line of black, a large triangle in front of the scutellum, pleura with spots above the front and middle coxæ, and a large median spot in front of the wing, a large spot is also present on each side of the metanotum, scutellum entirely yellow. Abdomen yellow, the extreme bases of the first to fourth segments black, the median interrupted bands on the second to fourth segments and occupying slightly oblique depressions, are brown, not black. Ventral segments brownish black, margined with yellow. Legs, including the coxæ, yellow, except the outer half of the front tibiæ and all the front tarsi, which are black. Halteres yellow. Anterior of the wing, as far as the fourth vein, clouded with brown, fifth vein widely margined with brown. Length 18 mm.

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Round Mountain, Blanco Co., Texas. Allied to *S. hamifera* Loew, and previously looked upon as a variation, but having so many distinguishing characters that it seems worthy of a specific name.

Xylota nebulosa sp. nov.

Male. Face yellow, front brownish, covered with a yellowish pubescence, cheeks brown, vertical triangle and occiput black, shining, antennæ and aristæ black, the third joint round. Thorax bronze black, the humeri whitish pollinose, pleura and scutellum black, somewhat shining. Abdomen black, the first segment shining, the second with two large yellow spots narrowly divided by dorsal line, expanding posteriorly into a large triangle, base margined with black which does not reach the lateral margin, third segment opaque, the side shining, fourth segment metallic green, covered with a yellow tomentum that is longer towards the posterior margin, fifth segment shining black. Venter brownish black, the second segment entirely yellow. Femora and coxæ black, tibiæ and tarsi yellow, the last two joints of the front and middle, and the last three joints of the hind tarsi, blackish, middle of the tibia brown. Halteres yellow. The outer half of the wing clouded with dark brown, base hyaline. Length 9 mm.

One specimen, Texas.

This resembles somewhat the figure and description of *X. pauxilla* Will., but the rounded, not elongated, third antennal joint, the less coarctate abdomen and the more heavily clouded wings, readily distinguish this species.

Epiplatea dohaniani sp. nov.

Male. Front brown, opaque, sparsely covered with short black hairs, the entire orbital margins whitish, face yellow, cheeks brown and about two-thirds the height of the eye, occiput brown, covered with short black hairs and whitish pruinose, sharply defined at the cheeks, antennæ yellow, arista dark brown, base yellow. Thorax dark brown with short black hair, macrochætæ as in the genotype

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(*E. erosa* Loew), pleura whitish pruinose, scutellum and abdomen dark brown, the fourth and fifth segments blackish. Halteres white. Legs light brown. Wings grayish hyaline with the tip beyond the outer cross-band whitish, the inner edge of this band poorly defined, the middle band extending from the costa (between the ends of the first and second veins), across the posterior cross-vein to the tip of the fifth vein, the inner band extending from the end of the auxiliary across the base of the discal cell to the tip of the anal vein, base of the wing yellow. Length 5 mm.

One specimen, collected by Mr. S. M. Dohanian, at Kelley Field, near San Antonio, Texas, April 27, 1918.

Stegana barretti sp. nov.

Female. Face whitish, cheeks brown, shining, front brownish black, opaque, antennæ brown. Thorax, scutellum and abdomen bluish black, shining, sparsely covered with fine black hairs, humeri and a large spot on the pleura below the base of the wing, snow white. Femora and tibiæ black, tarsi yellow. Halteres yellow. Wings hyaline, with a slight yellow tinge. Length 3.5 mm.

Collected at Amecameca, Mexico, Sept., 1900, by Mr. O. W. Barrett.

A SYMBIOTIC ORGANISM IN FULGORIDS.

By F. Muir,

Hawaiian Sugar Planters' Experiment Station, Honolulu, T. H.

When working on the natural enemies of the delphacid, *Perkinsiella saccharicida,* in Australia, in the latter part of 1919, I found that about eighty per cent of the eggs of this insect in the field were destroyed, and a fungus always present. At first I took the fungus to be the cause of the destruction of the eggs, but upon further investigation, I found that this was not so, and that these eggs were all punctured and their contents sucked up by a Mirid, *Cyrtorhinus mundulus* (Bred.).

Further observations revealed the fact that the young, adults

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and eggs of all Delphacidæ contained yeast-like cells very similar to the cells described by Speare in cutworms.* In the adult female *Perkinsiella* these organisms clustered around certain parts of the ovarian tubes and evidently penetrated the walls and entered the eggs where they could always be found congregated in a round mass at the posterior end of the egg. They appear to be held together by a viscid substance, for under a little pressure they flatten out and return to a sphere when the pressure is released. With greater pressure the ball bursts and the cells are dispersed. After the eggs are laid, this mass becomes reddish, due to minute red bodies; during development it works up to the anterior end of the egg and breaks up. Most of the cells appear to be thrown out of the embryo and lie under the egg cap, but a number remain within the embryo and multiply by end-building. After the young leave the egg-shell, the cells remaining within the shell germinate, develop hyphæ, and, if the conditions be favorable, fructify in a similar manner to *Sorosporella uvella* described by Speare.

All the species of Delphacidæ that I examined in Australia contained this organism, but in no species of Ciccadellidæ could I find any. All species of Hawaiian Delphacidæ so far examined contain them, and also *Siphanta acuta,* an introduced Australian fulgorid.

It appears that this organism is in no way inimical to its host. Perhaps it is beneficial, helping it to digest the starches and sugars which form a large percentage of its food.

This note is published in the hope that some student of mycology will make further investigations, work out the life history and identify the fungus.

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* Jour. Agri. Research XVIII. 8, 1920, pp. 399-440.

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PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB.

The annual meeting was held January 11th. The Secretary reported 11 meetings during the year, with average attendance of 22. Eleven members were elected and the present members number 81. The Treasurer's report showed that $923.28 had been paid for the publication of Psyche, and $943.06 received from subscribers. $58.00 had been received from assessments and $56.42 paid for general expenses. The editor of Psyche reported that the magazine had been reduced in size and 161 pages published, with a small number of illustrations which had been paid for by contributors.

The following officers were elected for 1921:

President .....Nathan Banks.
Vice-President .....L. R. Reynolds.
Secretary .....J. H. Emerton.
Treasurer .....F. H. Walker.
Executive Committee.....C. A. Frost, A. P. Morse, P. G. Bolster.

Prof. Brues, who had attended the entomological meetings of the American Association for the Advancement of Science at Chicago, gave an account of the proceedings. Prof. Wheeler gave an account of a visit to the entomologists at the University of Illinois.

Mr. A. P. Morse showed several grasshoppers and froghoppers especially abundant on the grass, *Andropogon scoparius,* widely distributed along the sea coast.

Mr. R. H. Howe, Jr., showed a diagram of the elevations of land in New England used for plotting the vertical distribution of insects.

Mr. Varás who had attended club meetings for the past three years and was about to return to his home in Chile, asked for correspondence and exchange of specimens.

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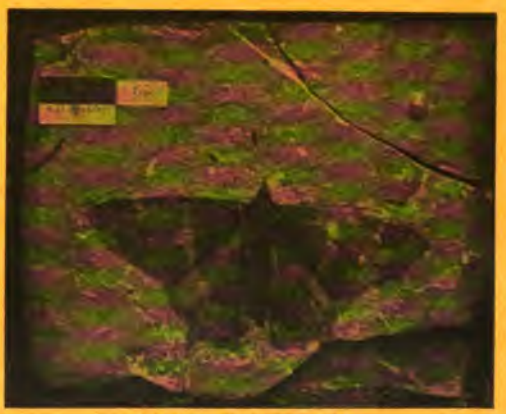

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REPRODUCTION IN THE APHIDIDÆ WITH A CONSIDERATION OF THE MODIFYING INFLUENCE OF ENVIRONMENTAL FACTORS.[1]

By Leopoldo B. Uichanco
College of Agriculture, University of the Philippines,
Los Baños, P. I.

Literature on aphids abounds in references to the existence of an "asexual" and a "sexual" reproduction. As a matter of fact, however, they reproduce sexually only, the term "sexual reproduction" being generally accepted by zoölogists as meaning reproduction by means of special reproductive cells, and "asexual reproduction" that method which involves a direct division, or budding, of an animal without the intercession of specific germ cells.

Reproduction in aphids may be subdivided into two categories: 1. *Amphigony.* This involves the union of reproductive cells of both sexes, the female gamete, or egg, necessitating fertilization by the male gamete, or spermatozoön, as a prerequisite to development. 2. *Parthenogenesis.* In this mode of reproduction the male gametes are dispensed with, the egg developing without having been previously fertilized. Hertwig and Kingsley (1912, p. 130) characterize parthenogenesis as "a sexual reproduction in which a degeneration of fertilization has taken place." In addition to the two foregoing methods of reproduction, occasional cases of *pædogenesis* (e. g., in *Aphis avenæ* Fabricius, as reported by Ewing, 1916, and in *Toxoptera graminum* Rondani, Webster and Phillips, 1912) have been reported. Pædogenesis is parthenogenesis occurring in the preadult stages of animals.

Amphigonous reproduction is considered as the more primitive method in insects, parthenogenesis being the result of a later specialization. The latter method of reproduction has become of normal occurrence in aphids and has practically supplanted the former, amphigony taking place only under the influence of adverse conditions in the environment. We have thus in aphids a

[1] Contribution from the Entomological Laboratories of the Bussey Institution, Harvard University. No. 191.

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very remarkable instance of a highly specialized group of sexually reproducing animals in which fertilization of the female reproductive cells as a prelude to development has been reduced to an apparently unnecessary and unessential physiological process.

General Features of Amphigony in Aphids.

In the amphigonous generation both sexes are, of course, represented. The presence of the male is the only characteristic of the amphigonous generation.

The main external characteristics of an amphigonous female are the general absence of wings (Baker, 1920), and the presence of an ovipositor in certain species (Buckton, 1882, p. 119). Davis (1908) also noted the presence of "sensoria" on the hind tibiæ as a secondary sexual character of the amphigonous female, "at least in the subfamilies Pemphiginæ, Schizoneurinæ, Lachininæ and Aphidinæ."[2] Internally, the most conspicuous features are the presence of a spermatheca and a pair of collaterial glands. The acessory glands, as well as the vagina, of which they are an evagination, and also the oviducts, are easily recognizable on account of their relatively thick walls. The large amphigonous eggs and their nurse cells are also very characteristic and are in evidence in the ovaries early in the embryonic stage of the mother. Cleavage and the formation of the blastoderm do not begin until after the eggs are fertilized and deposited. The amphigonous female is oviparous. The eggs are covered with a vitelline membrane and chorion.

General Features of Parthenogenesis in Aphids.

Among the aphids of temperate countries, aphidologists distinguish between (1) "stem mothers," which are the parthenogenetic individuals hatching from the overwintering amphigonous eggs, and (2) later parthenogenetic generations. The former are typically apterous; the latter, either apterous or alate. In the fall

[2] The typical genus of Schizoneurinæ, which is Schizoneura Hartig, 1837, is considered by Baker (1920) as a synonym of Eriosoma Leach, 1818. He grouped the latter under the tribe Eriosomatini of the subfamily Eriosomatinæ. The subfamily Pemphiginæ has been reduced by the same author to tribe Pemphigini under the subfamily Eriosomatinæ; and Lachninæ, to Lachnini under Aphidinæ.

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there is also a third form, the generation of 'sexupara," that is, parthenogenetic individuals which give rise to amphigonous forms. These are, as a rule, alate (Patch, 1920). In all specimens of parthenogenetic aphids which I have dissected neither spermatheca nor colleterial glands were found. The absence of these structures was apparently first reported by von Siebold (1839) and subsequently confirmed by other authors. In contrast with the amphigonous forms, the walls of the ovary are uniformly thin and membraneous, except at the vagina, where they are somewhat thicker.

Parthenogenetic aphids are viviparous, the entire incubation period being passed within the abdomen of the mother. This is a very unique characteristic, in view of the fact that a similar case does not occur in closely related families. The Phylloxeridæ, which is the only other family with the Aphididæ in the superfamily Aphidoidea, also have parthenogenetic generations, but they are always oviparous. In certain other families of the order Homoptera, like the Aleyrodidæ, parthenogenesis and viviparity are not correlated.

In parthenogenetic aphids, the development of the eggs proceeds in the ovaries long before deposition, eggs in the blastoderm stage having been observed within the abdomen of parthenogenetic embryos. There is no formation of a vitelline membrane and chorion.

Modifying Factors in the Production of Amphigonous Individuals.

As has been suggested elsewhere in the present paper, aphids seem to have the tendency indefinitely to reproduce parthenogenetically under favorable environmental conditions. As experimental evidence favoring this view may be cited Ewing's (1916) work on *Aphis avenæ* Fabricius, in which he found that he could maintain continuous and uninterrupted parthenogenetic reproduction through as many as eighty-seven generations in the material he experimented with on the Pacific Coast of the United States. In that region, oviparous forms in any aphid species had not been known, except in very few cases. His experiments, unfortunately, had to be brought to a close through the dying of all the individuals in his eighty-seventh generation from excessive heat; otherwise, he would probably have been able to observe parthogenetic reproduc-

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tion for a much longer period, if not indefinitely. Earlier investigators, like Bonnet (1745) and Kyber (1815), had previously observed the maintainence of continuous parthenogenetic reproduction in various species of aphids for long periods of time.

Males and oviparous females are known to be produced only under the prolonged influence of extremes of temperature, such as during the winter in temperate climates, and, as certain investigators claim, in cases of scarcity of food. Observations on this modifying action of climate and food, according to Buckton (1882, p. 109) were reported by Bonnet in 1745, and later confirmed by De Geer in 1773.

From our somewhat fragmentary knowledge of tropical aphids, we may tentatively infer, in the absence of more definite evidence to the contrary, that representatives of this family reproduce exclusively by parthenogenesis in warm countries. The following table gives a partial list of the localities in which a continuous parthenogenetic reproduction throughout the year has been observed. It will be noted that the various localities included in the list are characterized either by the total absence of winter or by a relatively mild climate.

LOCALITY	SPECIES	AUTHORITY
France (Orleans)	*Aphis rumicis* L.	Gaumont (1913)
Germany (Bremen?)	*Hyalopterus trirhodus* Walk.	Börner (1914)
	Rhophalosiphum lactucæ Kalt.	*ditto*
Holland	*Aphis gossypii* Glov.	van der Goot (1915)
	Aphis hederæ Kalt.	*ditto*
	Aphis abietina Walk.	*ditto*
	Aphis rumicis L.	*ditto*
	Eriosoma lanigera Hausm.	*ditto*
	Macrosiphum granarium Kirby	*ditto*
	Myzus persicæ Sulz.	*ditto*
India	*Aphis brassicæ* L.	Maxwell-Lefroy (1907)
	Aphis cardui L. var.	*ditto*
	Aphis gossypii Glov.	*ditto*

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South Africa	*Myzus persicæ* Sulz.	Moore (1912)
Sudan	*Aphis sorghi* Theob.	Vuillet (1914)
Sudan, Anglo-Egyptian	*Aphis sorghi* Theob.	Theobald (1904)
United States:—		
California	*Aphis avenæ* Fabr.	Ewing (1916)
	Macrosiphum rosæ Ream.	Russell (1914)
Florida	*Aphis brassicæ* L.	Quaintance (Herrick, 1911)
Indiana[3]	*Macrosiphum granarium* Kirby	Phillips (1916)
Texas	*Aphis pseudobrassicæ* Davis	Paddock (1915)
Virginia[3]	*Macrosiphum granarium* Kirby	Phillips (1916)
South Carolina	*Callipterus trifolii* Monell	Davis (1914)
Southern U. S.[4]	*Toxoptera graminum* Rond.	Webster and Phillips (1912)
Washington	*Pemphigus betæ* Doane	Doane (1900)

Supplementary to the above data may be cited here the other paper of van der Goot (1917, p. 2), who, after three years of biological and taxonomic work on the Aphididæ in Java, reported that he had never found amphigonous individuals in that country—not even at high mountain elevations where the temperature falls to the freezing point at night. Likewise, several years of casual observation and collecting in the Philippine Islands by me failed to disclose the male and oviparous-female forms. So far as I am aware, the occurrence of amphigonous aphid individuals in any other tropical country has not been definitely reported. It should be borne in mind, however, that failure to discover such forms in a given locality does not prove their non-existence there; although, when workers carrying on investigation for years in tropical regions report their inability to find amphigonous forms in any season of the year, there is some ground for suspicion that partheno-

[3] Amphigonous individuals and winter eggs of that species also found in this locality.

[4] South of the 35th parallel.

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genetic reproduction is continuous and uninterrupted, at least among the more common species of tropical aphids. If such a condition does obtain, the most reasonable explanation appears to be that in the tropics conditions are relatively more uniformly favorable to the aphids, both with respect to the climate and the nutritive factors in the environment.

Patch (1920), on the other hand, in a very interesting general treatise on the life cycle of aphids, remarks that "in tropical climates experiencing a wet and a dry season gamogenetic [amphigonous] eggs are produced to tide over the period of famine"; but unfortunately she does not cite any specific evidence or authority to support her thesis. It is not improbable, however, that some rare cases of amphigonous forms might occur in those tropical countries where, as she suggests, the year is divided between a wet and a dry season,[5] in view of the fact that in the height of the

[5] Such a condition obtains in the Philippine Islands, Java, and many other countries of the tropics of both hemispheres.

hot, dry season, when conditions are less favorable for many living organisms, certain species of insects are known to assume a resting state, presumably corresponding to hibernation in temperate climates.

In temperate countries, as a rule, reproduction of aphids by parthenogenesis is continuous during the milder seasons of the year, and amphigonous forms do not appear until the onset of the fall, when the low temperatures begin to affect the insects unfavorably. Exceptions to this generality are determined by the modification of the climate in a given region through the agency of various factors, such, for instance, as the prevailing winds blowing from the ocean and causing the summers to be "more moderate and the winters milder" on the Pacific Coast of the United States than in regions situated at similar latitudes in the interior and on the Eastern Coast.[6] The aphids in the former locality are thus subjected to comparatively more favorable conditions throughout the year and, consequently, they rarely, if ever, undergo heterogony (Ewing, 1916, and Swain, 1919, p. 8).

[6] R. DeC. Ward. 1918. Climate Considered Especially in Relation to Man, second edition, revised: 44. xvi+380 pp. G. Putnam's Sons, New York and London.

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The Nature of Influence of Extremes of Temperature and Lessening of Food Supply in the Determination of Amphigony.

It may be inferred from the foregoing considerations that winter, with its attendant low temperatures and inadequate food supply, plays a very important, if not an exclusive, part in the determination of amphigony. Amphigony correspondingly becomes of less frequent occurrence as winter becomes less severe in a locality, until in tropical regions where the temperature and, incidentally, the food supply also are more equably maintained throughout the year, amphigonous froms occur very rarely, if at all.

In this connection, it is interesting to note that, although heterogony has been brought about evidently as an adaptation to unfavorable environmental factors, the effects of low temperatures do not seem to be a necessary immediate stimulus in the production of amphigonous individuals and that aphid strains normally undergoing heterogony may continue to produce an amphigonous generation and lay eggs at least in the fall following the spring of the same year in which the insects from the open are taken into the greenhouse. The following experimental evidence, which has led me tentatively to arrive at this conclusion, is based on preliminary observations, which will have to be confirmed by further investigations under more adequate control:

In July, 1920, seedlings of *Tanacetum vulgare* Linnæus were transferred to the greenhouse of the Bussey Institution. At about the middle of August, after the plants had been well started, they were inoculated with their common aphid pest, *Macrosiphum tanaceti* Linnæus. The host plants appeared to grow normally and the aphids continually reproduced parthenogenetically until about the end of October, 1920. In October the temperature outdoors began to fall every now and then, especially at night, and at this time the greenhouse was kept heated to an average of about 65°F. This temperature had been observed previously by Ewing (1916) to be the optimum for aphids, in that it is least stimulating to the production of wings in the viviparous forms; and this behavior may be interpreted as an indication that the insects were under more favorable environmental conditions than the individuals which showed greater tendency to produce wings when subjected to other

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temperatures. In spite of the precautions observed in the present experiments, at about the end of October and the first week of November, 1920, when the tansy plants were still in apparently good condition, the aphids produced amphigonous individuals and laid winter eggs, in the same manner as the insects of identical species which were exposed to the more adverse weather conditions in their natural environment outdoors.

In the same greenhouse were a number of plants of *Nicotiana alata* Otto et Fink. These had been observed by me since September, 1919, to be infested with *Myzus persicæ* Sulzer. The insects, which are a common greenhouse pest in this part of the country, were probably descendants of parents that had been associated with greenhouse plants for a long period of time, and thus had been continually protected for generations from the drastic effects of winter. These individuals of *Myzus persicæ* in the greenhouse, which were under the influence of the same temprature conditions as the tansy aphids, continuously reproduced parthenogenetically throughout the winter of 1919-1920 and of 1920-1921.

At the time the above experiments were conducted, there was no facility available for a more accurate regulation of temperature and other conditions. The simultaneous presence in the same place of parthenogenetic forms of *Myzus persicæ,* however, tends to eliminate to some extent the possibility of adverse conditions existing in the greenhouse and bringing about amphigony in *Macrosiphum tanaceti.* Another difficulty in the present experiments was that I had no opportunity to work with material of identical species for control. However, under natural conditions outdoors in this locality, both *Myzus persicæ and Macrosiphum tanaceti* begin to produce winter eggs at about the same time of the year, in the fall.

In apparent contradiction to my findings on *Macrosiphum tanaceti* are the results reported by Slingerland (1893) in his work on *Myzus achyrantes* Monell, which species is considered by Gillette and Taylor (1908) as a synonym of *M. persicæ.* On April 2, 1890, Slingerland isolated the nymph of a wingless, parthenogenetic female, and within two years and ten months from that date he succeeded in raising from his material sixty-two successive generations of parthenogenetic individuals. The work was done

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at the Cornell Agricultural Experiment Station, at which locality winter is more or less severe, and this species is known, under natural conditions, to undergo an alternation of generations during the year. It should be noted, however, that *Myzus achyrantes* is a common pest of the greenhouses in Ithaca, as Slingerland himself admits in his paper. It is highly probable, although he does not specifically say so, that he obtained his material of this species from stock which had been in existence in the greenhouse for generations, and, as was the case with *Myzus persicæ* in the present experiments, the progenitors of the nymph with which he started his cultures might have come from a strain that had been reproducing exclusively by parthenogenesis as a result of prolonged seclusion from the untoward effects of winter. Under these circumstances then, Slingerland's results would tend to corroborate mine, instead of contradicting them. Nor would Ewing's (1916) eighty-seven continuous parthenogenetic generations of *Aphis avenæ* disprove my results, in view of the fact that the source of his material was the Pacific Coast of the United States, where this aphid has been known to reproduce normally by parthenogenesis for indefinite periods. This author himself states in his paper that he was unable to find amphigonous forms of the species outdoors during the entire time that his experiments were in progress. The results reported by earlier investigators, like Bonnet (1745) in France, on nineteen continuous parthenogenetic generations of *Aphis sambuci* Linnæus, and Kyber (1815) in Germany on parthenogenetic reproduction during a four-year period by *Macrosiphum rosæ* Linnæus (=*Siphonophora rosæ* Koch) and *Myzus persicæ* Sulzer (=*Rhophalosiphum dianthi* Schrank), may have to be classed in the same category as Ewing's or Slingerland's, for the reason that (1) at least one species, *Myzus persicæ,* as I have stated, is a common greenhouse pest, and (2) the material with which they worked might have come from stocks which, in their respective localities, had been reproducing outdoors normally by parthenogenesis throughout the year, cases of which have been reported lately from both countries (Gaumont, 1913, and Börner, 1914). In this event, their results would not tend to contradict mine.

It would not be safe, on the basis of the foregoing evidence, to

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formulate definite conclusions. The present observations, however, suggest the following preliminary deductions:

1. Heterogony in certain aphids of temperate climates has probably become a rhythmic process, occurring regularly at definite periods in their yearly cycle of generations and independently, for a period at least, of the immediate stimulus brought about by adverse temperature conditions.

2. Amphigonous reproduction in these aphids, although evidently maintained as an adaptation to, and under the influence of adverse climatic conditions, continues to occur at these definite cyclical intervals for some time after the causative factors have been removed.

The foregoing views find additional support in the fact that in nature in temperate climates amphigonous and parthenogenetic individuals of identical species in the same locality and feeding on the same parts of a host plant live side by side for considerable periods of time, even weeks, on the onset of the fall. I have noticed such a condition in Boston, and other workers have observed it elsewhere. This failure of all the individuals to respond simultaneously in the same manner to a given condition of the environment tends to show that environmental factors do not furnish the immediate or adequate stimulus in the determination of amphigony.

In 1907 Tannreuther (1907), in a paper on *Melanoxanthus salicis* Weed, *M. salicicola* Thomas, and several other species of aphids, announced somewhat similar views. He said in part that "external conditions, whether severe or normal, would not bring about the production of sexual generation before a definite number of parthenogenetic generations had intervened." He further noted, after two seasons of experimentation, that "if a stem mother and offspring were kept in favorable conditions in the greenhouse on the same species of hosts as out of doors, the time and length of period for each succeeding generation was approximately the same as out of doors, and that in both instances the sexual females and males appeared after the intervention of six parthenogenetic generations."

It may be necessary, at this juncture, to call particular attention to the fact that in the foregoing discussion the rôle of temperature in influencing the form of aphid reproduction is by no

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means belittled. As has been stated above, adverse temperature conditions evidently play a very important part in the determination of amphigony, and a uniformly mild temperature is apparently conducive to an indefinite maintainance of parthenogenetic reproduction. The point suggested, however, is that the effect of continuous subjection of an aphid strain which normally undergoes heterogony to mild temperature does not immediately become manifest. But this fact does not preclude the possibility that the cumulative effects on more than one yearly cycle of generations might bring about a change in the method of reproduction to one of continuous parthenogenesis. I have no data bearing on the reaction of the greenhouse aphids which reproduce continuously by parthenogenesis to the adverse weather conditions outdoors during the fall and winter months.

I am not prepared to discuss from personal observations the relation between scarcity of food and the determination of amphigony. There is apparently nothing in the literature which touches this subject, except the statement of Tannreuther (1907) that "abundance or scarcity of food is not a factor in determining the sex in the case of the aphids," for which, however, he presents no concrete experimental evidence. Of some possible interest in connection with this problem are the experiments by Gregory (1917), who found that by subjecting parthenogenetic individuals of *Macrosiphum pisi* Kaltenbach (=*M. destructor* Johnson) to varying periods of starvation, in certain cases carrying her experiments to the maximum possible points without killing the insects, she could induce the production from apterous mothers of alate offspring, which, as shown by her check cultures, would otherwise have been apterous. It is, however, apparent from her paper, although she does not state it, that the subsequent offspring of these starved aphids were invariably parthenogenetic and that the production of amphigonous individuals was not artificially induced by the treatment. It is to be regretted that she did not carry her experiments through the succeeding generations after the mother; and the question now arises as to whether the production of amphigonous individuals is induced only by the successive and cumulative effects of starvation on several generations of parthenogenetic individuals. One point is suggested by these experiments, and that is that, as

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in the case of temperature conditions, if the quantity of available food has any tendency at all to change the method of reproduction in aphids, the effect does not become apparent immediately. This question, however, needs further investigation before very definite conclusions can be reached.

Summary.

1. The sexual type of reproduction is the only one known to occur in the Aphididæ. This process takes three forms in this family: (a) amphigony; (b) parthenogenesis; and (c) pædogenesis.

2. Amphigony is considered as the more primitive method in insects. Parthenogenesis has practically supplanted it in aphid reproduction.

3. Parthenogenesis in aphids is apparently continuous and uninterrupted under favorable environmental conditions, amphigony occurring only under the influence of low temperatures and, as certain authors claim, inadequate food supply.

4. Aphids in tropical and other warm climates appear to have the tendency to reproduce exclusively by parthenogenesis. The same condition apparently obtains among greenhouse aphids in temperate climates.

5. Aphids in colder climates undergo heterogony as an adaptation to adverse environmental conditions. In certain species, the appearance of the amphigonous generation seems to be a rhythmic process, which continues to occur at definite cyclical intervals for some time after the influence of low temperature has been eliminated.

6. Nothing very definite is known about the relation of food and heterogony. If the quantity of food has any influence at all on the determination of amphigony in a parthenogenetic mother, the effect does not become manifest in the immediate offspring.

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CHINESE ANTS COLLECTED BY PROF. C. W. HOWARD.[1]

By William Morton Wheeler.

Since the publication of my paper on Chinese ants[2] Professor C. W. Howard has sent me a small collection made in Canton and the immediate vicinity. The collection comprises two very interesting undescribed species and several others which have not been previously recorded from China.

Ponerinæ.

1. *Stictoponera menadensis* Mayr subsp. *bicolor* Emery ☿ —Two specimens from Leng-oo, near Canton.

2. *Diacamma rugosum* Guill. subsp. *geometricum* Sm. var. *anceps* Emery. ☿ —Numerous specimens from Canton.

3. *Odontoponera transversa* Sm. ☿ —Several specimens from Canton and Honan Island, on which Canton College is situated.

4. *Ectomomyrmex astutus* Sm. ☿ —A single specimen from Leng-oo.

5. *Leptogenys* (*Lobopelta*) *diminuta* Sm. ☿ —Five specimens from Leng-oo.

Pseudomyrminæ.

6. *Tetraponera allaborans* Walk. ♀ —A single deälated specimen from Honan Island.

Myrmicinæ.

7. *Monomorium pharaonis* L. ☿ ♀ —Many specimens from Canton.

8. *Monomorium carbonarium* Sm. ☿ —Eleven specimens from Canton.

9. *Cardiocondyla nuda* Mayr. ☿ —Three specimens from Canton.

10. *Crematogaster rogenhoferi* Mayr. ☿ ♀ —Several specimens from Canton.

11. *Crematogaster biroi* Mayr. ☿ —Two specimens from Canton.

12. *Pheidologeton diversus* Jerd. ♂ ☿ —Many workers and a single soldier from Canton. One lot of workers attending scale-insects.

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 194.

[2] Bull. Mus. Comp. Zool. 64, 1921, pp. 529-547.

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DOLICHODERINÆ.

13. *Dolichoderus* (*Hypoclinea*) *taprobanæ* Sm. var. *gracilipes* Mayr. ☿ ♀ ♂—Numerous specimens from Canton.

14. *Dolichoderus* (*Hypoclinea*) *affinis* Emery var. *nigricans* Emery. ☿—Numerous specimens from Tei-loi and Loh-Kong, Canton.

15. *Dolichoderus* (*Hypoclinea*) *sinensis* sp. nov. (Fig. 1).

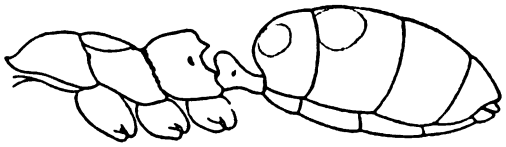

Fig. 1 *Dolichoderus* (*Hypoclinea*) *sinensis*, *sp. nov.*, *worker*.

Worker. Length 3.4 mm.

Closely related to the Palearctic *D. quadripunctatus* L. but differing in the following particulars: Joints 3-7 of funiculi shorter, not longer than broad; mesonotum slightly longer, more nearly parallel-sided; base of epinotum much more elevated and convex and broader in proportion to its length; its posterior corners depressed and developed as small, rather acute teeth, not as tubercles. Petiolar node distinctly lower and more evenly rounded above in profile, the cylindrical portion behind the node longer.

Surface of head, thorax and petiole much more opaque; the foveolæ on the head and thorax more regular and more distinct. Mandibles, clypeus and pleuræ slightly shining, or lustrous, finely shagreened. Gaster very smooth and shining.

Pilosity and pubescence quite as feebly developed as in *quadripunctatus*.

Head, thorax, petiole and legs deep red, the tibiæ slightly darker; tarsi, mandibles and antennæ slightly paler, the tips of the scapes and funiculi infuscated. Gaster black; first and second segments as in *quadripunctatus*, each anteriorly with a pair of ivory yellow but somewhat larger spots.

Described from a single specimen from Canton.

16. *Technomyrmex albipes* Sm. ☿—Numerous specimens from Canton; attending mealy bugs.

17. *Iridomyrmex anceps* Roger ☿—Nine specimens from Canton.

18. *Tapinoma indicum* Forel ☿—Six specimens from Leng-oo.

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FORMICINÆ.

19. *Plagiolepis longipes* Jerd. ☿—Several specimens from Canton.

20. *Plagiolepis rothneyi* Forel ☿—Numerous specimens from Canton.

21. *Paratrechina longicornis* Fabr. ☿—Numerous specimens from Canton.

22. *Paratrechina* (*Nylanderia*) *yerburyi* Forel ☿—Numerous specimens from Canton.

23. *Gesomyrmex howardi* sp. nov. (Fig. 2).

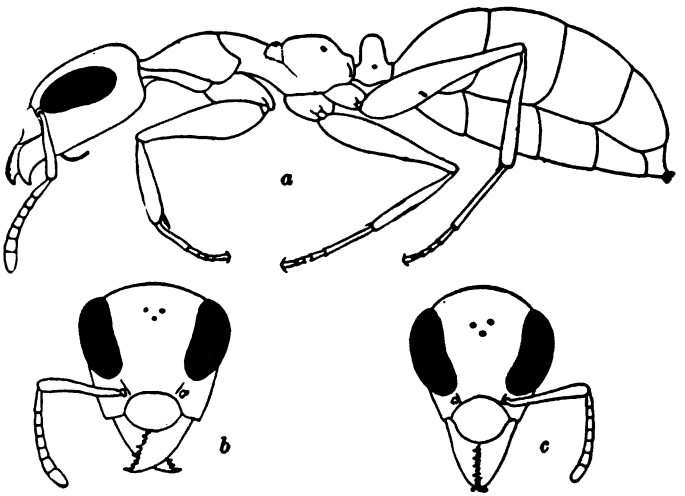

Fig. 2. *Gesomyrmex howardi* **sp. nov. a, worker major; b, head of same, c, head of worker minor.**

Worker major. Length 3 mm.

Head, without the mandibles, a little longer than broad, broader behind than in front, with straight, anteriorly angular cheeks, convex and broadly rounded posterior border and corners, broadly and arcuately excised occipital border and rather flat dorsal and gular surfaces. Eyes very large, prominent, elliptical, fully 2½ times as long as broad, situated at the middle of the sides of the head. Ocelli minute but distinct. Mandibles rather flat, their external borders straight at the base, convex towards the tips, their apical borders straight with acute, crowded teeth, alternately long and short. Clypeus broader than long, convex but not carinate in the middle, flattened and depressed anteriorly where it projects as a broad, arcuate lobe over the bases of the mandibles. Frontal

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carinæ very short, twice as far apart as their distance from the lateral borders of the head, running back towards the anterior orbits. Frontal area and groove obsolete. Antennæ short, 8-jointed, scapes somewhat thickened apically, not reaching to the posterior orbits; funiculi gradually thickened to their tips, all their joints longer than broad. Thorax long and slender; broadest through the pronotum, much narrowed at the mesonotum; pronotum seen from above elliptical, a little longer than broad, its dorsal outline evenly rounded, continued back into that of the sloping mesonotum to the constriction, which is sellate and bears on each side a swelling with one of the metanotal spiracles. Base of epinotum rising somewhat above the constriction, slightly but distinctly convex, longer than the feebly concave, sloping declivity. From above the epinotum is a little longer than broad and slightly narrower than the pronotum, the mesonotum less than half as broad as the latter. Petiolar node nearly as high as the epinotum, transverse, erect, as thick above as below, its anterior and dorsal surface rounded, its posterior surface more flattened; seen from behind it is broader above than below, with broadly rounded superior corners. Gaster moderately large, elliptical, its first segment not longer than the second. Legs moderately long, femora all distinctly incrassated at the base, tibiæ subcylindrical, their bases slightly constricted. Tarsal claws slender and rather straight.

Shining; finely but sharply shagreened; thorax and petiole, except the pronotum, subopaque, finely and densely punctate. Mandibles, clypeus and front of head with fine, dense, superficial, longitudinal striæ.

Hairs and pubescence whitish; the former absent except on the clypeus, palpi and tip of the gaster; the pubescence extremely short and dilute, distinct only on the antennal funculi.

Dull honey yellow; legs scarcely paler; mandibles, clypeus and antennæ more whitish; eyes black; mandibular teeth reddish brown.

Worker minor. Length 2. 3mm.

Differing from the major in its smaller size, narrower head, proportionally larger, more prominent and slightly more reniform eyes, even more minute ocelli, shorter, less angular and anteriorly more convergent cheeks; longer and more anteriorly produced clypeus and more slender mandibles.

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Described from two specimens from Canton, both from the same vial in which they were mingled with several other ants.

This is the fourth species of *Gesomyrmex* to come to light. The genus was established by Mayr in 1868[3] for a species, *hoernesi*, from the Baltic Amber. Emery, in 1891, referred a peculiar form, *corniger*, from the Sicilian Amber to the same genus,[4] but I have recently made it the type of a distinct though allied genus, *Sicelomyrmex*.[5] In the same paper I described a second species of *Gesomyrmex, annectens*, from the Baltic Amber. In 1892 Ernest Andre[6] described and figured an extant species, *capperi* from the Kapouas Basin of Borneo. This insect has not been seen since. It is therefore of considerable interest to find on the Asiatic continent a second living *Gesomyrmex*. It is evident that the Bornean and Chinese species are very rare and probably vanishing relicts of a group of Formicinæ with huge eyes and 8-jointed antennæ, which was represented by numerous species during the Oligocene and Miocene Tertiary. To this group we must also assign the allied genera *Sicelomyrmex* and *Dimorphomyrmex*. The latter is known from two species from the Baltic Amber, *theryi* Emery and *mayri* Wheeler, and three extant species, *andrei* Emery and *janeti* Ern. André from Borneo, and *luzonensis* Wheeler from the Philippines.

Judging from André's figures and description, *Gesomyrmex howardi* differs from *capperi* in its smaller size, less reniform eyes, broader pronotum, more cylindrical mesonotum, more convex epinotum, thicker petiole and more uniform honey-yellow color. André's specimens measured 3.5 to 4 mm. and seem to have been minor workers. Since the major worker measures in all probability not far from 4.5 mm. *capperi* must be considerably larger than the Chinese species. The amber specimens which I described as *annectens* may, perhaps, be major workers of *hoernesi*, but the measurements seem not to favor this supposition, since *annectens* varies from 4 to 6 mm., *hoernesi* from 2.5 to 6 mm. The great similarity of all four described species of *Gesomyrmex* leads me

[3] Die Ameisen des baltischen Bernsteins. Beitr. Naturk. Preussens. Physik. Ökon. Ges. Königsberg 1, 1868, pp. 1-102, 5 pls.

[4] Le Formiche dell'Ambra Siciliana nel Museo Mineralogica dell'Universita di Bologna. Mem. R. Accad. Sc. Ist. Bologna (5) 1, 1891, pp. 141-165, 3 pl.

[5] The Ants of the Baltic Amber. Schrift. physik. ökonom. Ges. Königsberg 55, 1914, pp. 1-142, 66 figs.

[6] Voyage de M. Chaper a Borneo. Catalogue des Fourmis et Description des Espèces Nouvelles. Mém. Soc. Zool. France 5, 1892, pp. 46-55, 5 figs.

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to suspect that the amber specimens, which I examined, may represent more than two very closely related forms. The worker major of *G. howardi* shows that the genera *Gesomyrmex* and *Dimorphomyrmex* are more closely related than was supposed. Nevertheless, the gizzard of *D. andei* figured by Emery[1] is quite different from the gizzard of *G. capperi* figured by André. In the former insect the organ is short and broad with short, terminally reflected calyx-lobes, in the latter long and slender and more as in *Camponotus* and *Oecophylla*.

The thickened bases of the femora of *G. howardi* indicate that this ant can jump like the large-eyed *Gigantiops destructor* Fabr. of the Neotropical Region, and the rather feeble tarsal claws would seem to indicate that it is not arboreal but nests in the ground.

24. *Camponotus* (*Myrmoturba*) *nicobarensis* Mayr ☿ ♀—Many specimens from Honan Island, Canton.

25. *Camponotus* (*Myrmoturba*) *mitis* Sm. ☿—Many specimens from Canton.

26. *Camponotus* (*Myrmoturba*) *barbatus* Roger var *albosparsus* Forel ☿—Eight specimens from Canton.

27. *Camponotus* (*Myrmosericus*) *rufoglaucus* Jerd. subsp. *paria* Emery ☿—Numerous specimens from Tei-loi, Canton.

28. *Polyrhachis* (*Myrma*) *mayri* Roger ☿—Three specimens from Canton.

29. *Polyrhacis* (*Myrmhopla*) *dives* Sm. ☿ ♂—Numerous specimens from Canton.

30. *Polyrhachis* (*Cyrtomyrma*) *rastellata* Sm. subsp. *laevior* Roger var. *debilis* Emery ☿—Three specimens from Canton.

[1] Descriptions de deux fourmis nouvelles. Ann. Soc. Ent. France 63, 1894, pp. 72-74, 2 figs.

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ON SOME RECENT REMARKS ON THE PHYLOGENY OF HOMOPTERA.

By F. Muir,
Hawaiian Sugar Planters' Experiment Station,
Honolulu, T. H.

In a recent publication Dr. G. C. Crampton[1] remarks: "In any phylogenetic study we must consider the lowest representatives rather than the highly specialized members of a group."

Unfortunately Dr. Crampton, on more than one occasion when discussing the phylogeny of Homoptera, has not followed this good advice. In a recent paper[2] he has compared the wing of a Psyllid and a wing of a Psocid and concluded that their similarity is due to their common ancestry. The Psocid wing he figures is a specialized one and not the lowest representative of the group, and Psyllidæ are highly specialized Homoptera. Any similarity between the venation of the wings of these two insects is therefore of no phylogenetic significance, but due to convergence.

As I am not an authority upon the Psocidæ I can only support my contention by a comparison of the Psocid wing figured by Dr. Crampton with such genera as *Amphientomum* and *Cymatopsocus,* where the venation is more generalized but still too specialized to be ancestral to the Homoptera.

My contention that the Psyllidæ do not represent the primitive type of Homoptera is based upon a detailed study of the suborder. The evidence is too lengthy to give in detail in this paper, but the following is a brief summary of some of the points.

The Hemiptera form a homogeneous and monophyletic order characterized by a unique shape and arrangement of the mouth parts found in no other order of insects. Although the order is of great size and the forms found within it are very diverse, yet the mouthparts are always of the same type and far more uniform than is found in any other of the large orders. That such a type of mouth organs should have arisen independently in two or more groups seems highly improbable.

The nearest approach to the Hemipterous mouthparts is found

[1] Proc. Ent. Soc. Washington 23, 2, p. 37 (1921).
[2] Ent. News XXII, No. 4, p. 97-105 (1921).

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in the Thysanoptera. But here we find two distinct types of mouth organs and both are so dissimilar to the Hemiptera that it is not likely that one arose from the other. The Psocidæ possess a semi-free maxillary style which may represent a condition found in the ancestors of the Hemiptera, but no Psocids that we know today could have been that ancestor because they are far too specialized in certain directions.

The most generalized head in the Hemiptera is found among the Heteroptera where the gula is well developed or very large, the head capsule of more normal shape and position, the labium is four-jointed and consists of a submentum, mentum, subgalea with amalgamated paraglossa and lacinia. In some few species the labial palpi are also present. In the Homoptera the gula has disappeared or is represented only by a membrane, and the labium is in close association with the pronotum. The reduction of the gula has drawn the head downward and under, bringing the top of the head to the front and altering the whole shape of the head capsule. In this respect the Cicadoidea are more primitive than the Fulgoroidea.

In the Sternorhynchi this line of evolution of head set up in the Auchenorhynchi is carried to a still greater extent. In the Psyllidæ the clypeus, frons (bearing the phrayngeal muscles), tentorial structure and the labium have separated themselves from the head capsule and become still more closely connected with prosternum. To accommodate the long mandibular and maxillary setæ an invagination at the base of the labium penetrates the prothorax. In the Coccidæ the reduction of the head capsule is carried to the extreme, so that the frons, clypeus, tentorial structure, labium and the styles are isolated in a membraneous area and appear to be thoracic structures. The line of evolution of the head of the Hemiptera is so well defined that any student of comparative morphology, except an extreme mutationist, will agree that the Psyllidæ are highly specialized and do not represent the ancestral form.

The Hemiptera can be divided into two groups on the condition of the alimentary canal. In the Heteroptera, Fulgoroidea and Cicadellidæ this is simple. In the Cicadadæ, Cercopidæ, Membracidæ and the Sternorhynchi the posterior portion of the midgut is in intimate contact with the anterior portion and forms a filter

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chamber. This is of a simple nature in the Psyllidæ. The fact that this division separates the Cicadellidæ and the Membracidæ raises difficulties, as they are otherwise so closely related. It seems improbable that such a condition arose in two or more groups independently. It seems more probable that it has been lost in two or more groups independently. Kershaw has shown that the connection is fully developed in nymphs when hatched, so that it is an embryonic character and not a later development to meet special conditions.

Judging by venation the Hemiptera must have divided into two groups, the Homoptera and Heteroptera, early in the history of the order, but not early enough, in my opinion, to justify making it into two orders. A very slight study of the venation of the Homoptera shows that the nearest approach to the hypothetical ancestral type is not found among the Psyllidæ but among the Auchenorhynchi.

A study of the hind legs also indicate a state of high specialization in the Psyllidæ.

Again, in discussing the male genitalia of Homoptera, Dr. Crampton has offended against his own advice. Although there are several distinct types of both male and female genitalia among the Auchenorhynchi he has selected Ormenis as the type to homologize with other orders. But unless it can be shown that this genus possesses a generalized type, any homologies drawn from it are of little phylogenetic value.

Among the Cicadoidea we have two distinct types of male genitalia and a third in the Fulgoroidea. Cicadadæ have no genital styles or these are only rudimentary and are articulated and the aedeagus comparatively simple. This is most likely specialization by reduction. In the other Cicadoidea there are two pairs of appendages, the outer pair or plates and the inner pair. In some forms the outer pair are amalgamated together and appear to be part of the pygofer. In the Membracidæ the aedeagus is generally simple; in the Cercopidæ it is often complex; in the Cicadellidæ it is of various forms, some of which are highly complex and others greatly reduced. In the Fulgoroidea there is only one pair of styles, which in certain cases are amalgamated into a single organ.

Both the inner styles of the Cicadoidea and the styles of the

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Fulgoroidea are in connection with the base of the ædeagus. They are probably homologous.

In the Fulgoroidea there is great diversity of structure and it is very difficult to decide which is the most generalized. In certain forms (i. e., certain Delphacidæ) it is of a simple tubular nature with a small ring round its base. In other forms this ring is greatly enlarged and forms an outer tube around the inner tube. In some forms there are even three tubes and one may be exceedingly complex.

Until we understand the homologies of the various types within the order Hemiptera any homologizing with other orders is but guesswork and not scientific evidence, although the guesses may be correct.

Dr. Crampton has so often associated the Psocidæ and Psyllidæ together, as if the latter were descended from the former and all else followed naturally, that there is a possibility of readers not acquainted with the Homoptera accepting that conclusion as well founded. For that reason I raise the above objections.

Certain remarks in Dr. Crampton's papers leads one to believe that he holds views on evolution considerably different to those of the majority of biologists; or his metaphors are so anthropomorphic that they are misleading. As an example of this I quote from a recent work:[3]

"Taking their anatomy as a whole, the Hymenoptera show undoubted affinities with the Neuropteroid insects (i. e., the Neuroptera, Mecoptera, Tricoptera, etc.), but they also present certain points of similarity to the Psocoid insects, such as the Homoptera, Thysanoptera, Psocida, etc. The lines of development of all of these forms apparently arose from ancestors intermediate between the Zoraptera (with the Isoptera) on the one side, and the Coleoptera (with the Dermaptera) on the other—much as a family of children inherit traits from the father's side—and I am inclined to consider that the Hymenoptera inherited their social tendencies from the side of the Zoraptera (with the Isoptera) while their type of genitalia apparently comes from the side of the Coleoptera (with the Dermaptera)."

Does Dr. Crampton believe that new orders arise as hybrids from the crossing of individuals belonging to different orders, or are things not what they seem in the quoted paragraph?

[3] Ent. News XXXII 5, (1921) p. 137.

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NOTES AND DESCRIPTIONS OF A FEW NORTH AMERICAN DOLICHOPODIDÆ (DIPTERA).

By M. C. Van Duzee
Buffalo, N. Y.

Diaphorus hirsutus sp. nov.

Male: Length 4–4.5 mm.; of wing 4 mm. Face narrow, silvery white. Palpi yellow, proboscis brownish. Front nearly opaque with grey pollen, the ocular tuburcul more blackish; ocullar bristles long, a bristle close to the orbit on each side curves forward. Antennæ black; first joint long, hairy above; second joint large with rather long bristles at tip; third small, not as large as second, rounded at tip; arista basal, long, pubescent. Lateral and inferior orbital cilia whitish, five or six of the upper cilia on each side black.

Thorax nearly opaque with brown pollen, the median line on the dorsum and the scutellum green, quite shining; acrostichal bristles small, in a single row; six large dorsocentral bristles on each side; scutellum with four large bristles on its margin; pleuræ more blackish with gray pollen, its posterior edge yellow. Abdomen yellow with the posterior edge of first segment, large triangles on the dorsum of second, third and fourth, which nearly reach the preceding segment on the median line and the sides on the posterior margin of the segments, and nearly the whole of fifth and sixth segments, shining green or bronze; hairs on the dorsum rather long, especially near the base of the abdomen, those on the sides of the abdomen yellowish. Hypopygium rather conspicuous, blackish, still more or less yellow towards the ventral point; its appendages small brownish lamellæ, it has about four rather long and conspicuous, although not very stout bristles at tip.

Coxæ yellow; middle pair with a blackish streak on outer side; fore and middle pairs with black bristles on the apical half of their anterior surface. Femora and tibiæ yellow, very hairy; fore femora with a few slender bristles on the apical part of the lower posterior edge, which are as long as the width of the femora; posterior femora infuscated on apical half of upper surface, and the slender hairs of their lower surface as long as the width of the femora; bristles on upper surface of the tibiæ small and incon-

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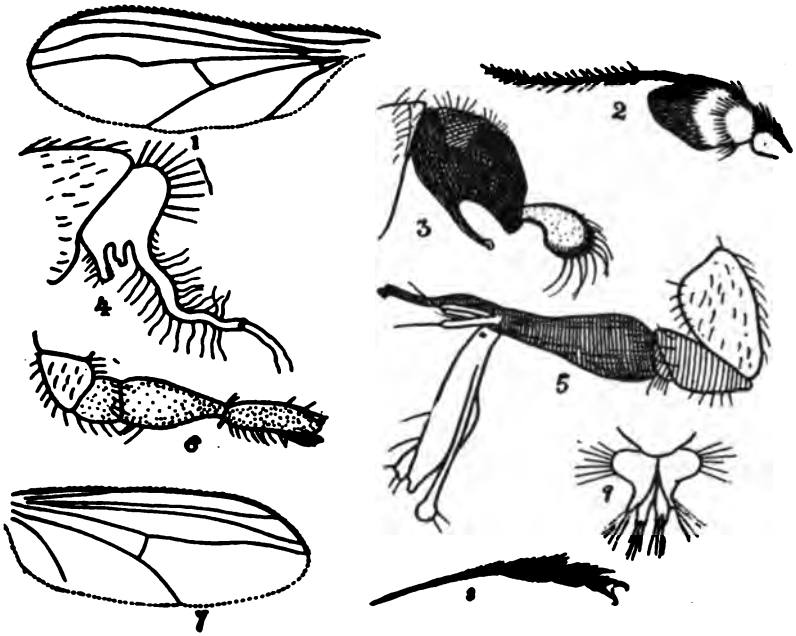
spicuous. Tarsi hairy, more or less blackish from the tip of the first joint; fore and middle tarsi nearly as long as their tibiæ, the former with fourth and fifth joints of about equal length. All fifth tarsal joints with bristle-like hairs at tip; their pulvilli much enlarged and with the empodium also elongated and hairy, appear-



EXPLANATION OF FIGURES.

Fig 1, Diaphorus hirsutus sp. nov., wing.; Fig. 2, Proarchus violaceus sp. nov., antenna; Fig. 3, Proarchus violaceus sp. nov., Hypopygium; Fig. 4, Leucostola terminalis VanDuzee, hypopygium of male; Fig. 5, Thripticus longicauda sp. nov., hypopygium of male; Fig. 6, Thripticus nigripes sp. nov., hypopygium of male; Fig. 7, Paracilus ornatus sp. nov., wing; Fig. 8, Paracilus ornatus sp. nov., last four joints of fore tarsus; Fig. 9, Paracilus ornatus sp. nov., outer appendages of the hypopygium of male.

ing like claws when seen with a low-power lense; hind tarsi scarcely as long as their tibiæ, the first and second joints of nearly equal length. Calypters and halteres pale yellow, the former with a brown tip and yellowish cilia.

Wings (Fig. 1) grayish; first vein reaching a little more than one-third the distance from the root of the wing to tip of second vein; third vein bent backward at tip; last section of fourth vein with a quite abrupt bend at a point opposite the tip of fifth vein,

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from which point it is parallel with third vein and ends in the apex of the wing; sixth vein reaching the wing margin; anal angle rounded but rather full, the wing being of somewhat parallel width.

Female: Two females which seem to belong here have the face wide, still rather narrow for a female, white. They have only the second and third abdominal segments yellow on the dorsum, these have the same metallic triangles as are found in the male; the legs and feet have only short hairs; the scutellum has one pair of bristles; the second vein reaches only half the distance to the tip of second; last section of fourth vein is nearly straight and parallel with third.

Described from three males and two females from California; the males were taken at Berkeley, Calif., May 10, 20 and 28, 1915; the females at Alpine, San Diego County, April 8 and 11, 1915. Type in the author's collection.

Diaphorus fuscus nom. nov.

D. adustus Van Duzee, Bulletin of the Buffalo Society of Natural Sciences, Vol. XI, p. 173, 1915, as the name *Diaphorus adustus* Wied. of Europe has precedence. I would change the name of my species to *Diaphorus fuscus*.

Leucostola terminalis Van Duzee.

In the Entomological News, Vol. XXV, p. 405, I described a female under this name. Since then I have seen several male specimens, one of which is in my collection. It agrees with the female described in having the first antennal joint wholly yellow, it also has the reddish coppery stripes above the root of the wing, although they are not as conspicuous and are divided into two spots, one at the suture and one above the root of the wing. It has the last two joints of the middle tarsi, a little flattened, of about equal length, each nearly as wide as long, the two taken together about as long as the third joint; hind tibiæ black at tip for nearly one-fourth their length; hind tarsi wholly black, the second joint a little longer than the first; last section of fourth vein only a little bent at its middle; hypopygium (Fig. 4) with its lamellæ developed into long hairy filaments, and with two bristles at tip, which are slender and hair-like.

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Proarchus (*Phylarchus*) Aldrich.

Dr. Aldrich described this genus from two females taken in Mexico, and has placed the genus in the Thinophilinæ. I have a species found in New York and Virgina which I am placing in that genus. It has the antennæ and plumose arista as in his species, the face of the female is as he described it (about as in Pelastonerus). My specimens have distinct acrostichal bristles, while his species was destitute of these bristles. The hypypygium of this new species is large, extending forward under the venter, as in Dolichopus and its lamellæ are as in that genus (fig. 3). If the male of his species proves to have the hypopygium as in my species, it would place the genus in Dolichopodinæ, I should say after Polymedon, or perhaps after Sarcionus and next to Pelastoneurus, from which it is separated by its nearly parallel third and fourth veins.

This would place the genus near the European genus Poecilobthrus Mik. The female of the only species of that genus that I have seen, *P. nobilitans,* has the face formed very much as in Pelastoneurus and has a plumose arista. I should place our species in that genus, only the second and third veins are not approximated nor the wing of the male ornamented with black as in all species of Poecilobothrus known to me.

Proarchus violaceus sp. nov.

Male: Length 4–4.5 mm.; of wing 4 mm. Face wide, covered with grayish-white pollen, sometimes almost silvery, upper portion a little concave and with a slightly depressed median line, the lower part rather short and slightly convex. Front dark violet, sometimes almost black, a little dulled with brown pollen. Palpi yellow with black hairs and a little white pollen. Antennæ (fig. 2) yellow; third joint sometimes mostly brown, short, somewhat oval in outline; arista dorsal, distinctly plumose, although the hairs are not long. Orbital cilia wholly black.

Dorsum of the thorax violet with the lateral and anterior margins quite broadly greenish; acrostichal bristles rather large, in two rows; scutellum violet with two large and two very small bristles on its margin; pleuræ more black with gray pollen. Abdomen green with white pollen; incisures black; hind margins of segments with stiff black bristles. Hypopygium (fig. 3) formed

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about as in Dolichopus, black, greenish on basal half; its lamellæ large, somewhat oval but tapering into the stem, yellowish with a wide black border on the apical margin, which is jagged and fringed with long black bristles.

Coxæ, femora and tibiæ yellow; middle coxæ blackened on outer surface, hind ones a little infuscated at base; fore coxæ covered with black hairs on their anterior surface, hind ones with one large and one small bristle on outer surface. Middle and hind tobiæ each with four blackish spots on upper surface where the bristles are inserted. Fore tarsi a little longer than their tibiæ, a little blackened from the tip of the first joint; middle and hind tarsi black from the tip of the first joint, the latter with the first joint distinctly shorter than the second. Calypers and halteres pale yellow, the former with black cilia.

Wings grayish, tinged with brown in front of the third vein; broad, distinctly expanded at tip of fifth vein; anal angle prominent, although the hind margin of the wing is slightly excavated at tip of sixth vein; costa slightly thicker from the tip of the first vein; last section of fourth vein nearly straight, ending a little before the apex of the wing, nearly parallel with third vein, which is a little bent backward so as to approach fourth vein a very little at tip; cross-vein a little more than its length from the wing margin, measured on fifth vein.

Female: Face a little wider than in the male; color of head, thorax, abdomen and legs as in the male; wings as in the male, but not quite as wide at tip of fifth vein.

Described from three males and three females; I took the holotype and allotype at Dayton, Erie County, N. Y., July 5, 1920; two males were taken by Mr. Banks at Falls Church, Va., May 30; one female was taken by Mr. Hine at Kent, Ohio, June 18; and one female was taken at Bridgewater, Mass., July 11.

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Thrypticus nigripes sp. nov.

Male: Length 1.75 mm. Face, front, thorax and abdomen dark shining blue-green. Face very narrow below. Antennæ and mouth parts black. Bristles of the thorax and the conspicuous hairs on the abdomen yellow. Hypopygium blue-green, its hairs yellow;

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the lamellæ brown, large, about as long as the main portion of the hypopygium, rather bare (fig. 6).

Coxæ, legs and feet black, except the extreme tips of the coxæ and the trochanters, which are yellowish. Calypters, their cilia and the halteres yellow.

Wings nearly hyaline; third and fourth veins nearly parallel.

Female: Face a little wider; otherwise about as in the male.

Described from one male and two females which I took at Wells, Nev., June 6, 1915. Type in the author's collection.

The wings in all my specimens are in poor condition. This is very much like *T. fraterculus* Wh., it differs in having the capsule of the hypopygium conical, not oval as in Wheeler's species, and the lamellæ much longer and less hairy.

Thrypticus longicauda sp. nov.

Male: Length 3 mm. Face green, narrow below, the lower edge and the palpi covered with white pollen. Front blackish. Antennæ black, small. Lateral and inferior orbital cilia white. Frontal bristles black.

Thorax green with bronze reflections; there is but one bristle left on the thorax and that is black with the tip more whitish, the minute hairs on the anterior portion are yellow. Abdomen long and slender, green, its hairs and the bristles on the hind margins of the segments are yellow, but they are small and inconspicuous. Hypopygium long and slender, green, its hair yellow (fig. 5); its lamellæ very long, yellow, with a few yellow hairs.

Fore coxæ yellow with white hairs, its basal half on the anterior surface green. Middle and hind coxæ and all the femora green, with the tips of coxæ, extreme base of middle and hind femora, apical third of fore, and apical two-thirds of middle femora, tips of hind femora, and all tibiæ and tarsi yellow. Fore and middle tarsi nearly twice as long as their tibiæ. Second joint of hind tarsi longer than the first. Calypters, their cilia and the halteres yellow.

Wings grayish; costa black; veins brown; third and fourth veins parallel, the fourth ending in the apex of the wing; last section of fifth vein nearly three times as long as the cross-vein.

Female: Face wider; thorax with black and yellow bristles mixed; coxæ and femora mostly black; tibiæ and tarsi yellowish

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brown; fore tarsi scarcely one and a half times as long as their tibiæ. Wings as in the male.

Described from one pair which I took at San Francisco, California, May 12, 1915. Type in the author's collection.

Paraclius minutus sp. nov.

Male: Length 2.5 mm.; of wing 2 mm. Face rather narrow, covered with white pollen, the suture near apical third, lower portion flat. Palpi blackish with a little white pollen and black hairs. Front almost opaque with brown pollen. First two antennal joints yellow; third mostly brown, small, rounded at tip. Arista long with long pubescence, but scarcely plumose. Inferior orbital cilia whitish.

Thorax greenish, dorsum more brown with coppery reflections, which form a median vitta extending to the hind margin of the scutellum. The ante-alar black spots distinct but nearly divided by the green of the dorsum; when viewed from behind there are four silvery-white spots visible, a large one at the lower edge of the front end of the black spot, and a very small one above the root of the wing; pleauræ and coxæ covered with white pollen. Abdomen green; the spots of white pollen on its sides not very conspicuous. Hypopygium rather small, entirely sessel, black; its lamellæ quite small, black, they appear to be nearly bare on their edges.

Coxæ yellow, middle ones blackened on basal half, hind ones a little blackened at base; anterior pair with black hairs on their front surface. Femora and tibiæ yellow. All tarsi black from the tip of the first joint. Calypters and halteres yellow, the former with black cilia.

Wings tinged with brownish gray; first section of costa not thickened, last section of fourth vein rather abruptly bent beyond its middle, beyond which it curves forward so the tip is near the tip of the third vein; last section of fifth vein a little longer than the cross-vein.

Female: About like the male in the width of the face, color and venation, except that the last section of the fifth vein is a little longer.

Described from two males and three females which I took in

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Florida, four at Bradentown and one pair at Anna Maria Key, all in March. Type in the author's collection.

This is much like *P. quadrinotatus* Ald., but does not have the anta-alar spots divided as in that species, and these spots are not as large.

Paraclius ornatus sp. nov.

Male: Length 3–3.5 mm.; of wing, the same. Face narrow, silvery-white. Palpi small, yellow, with a black bristle at tip. Proboscis yellow, with a fringe of little yellow hairs on its edge. Front silvery-white, widened above. Antennæ wholly black or with the lower edge of the first joint slightly yellowish; third joint small, about as long as wide, scarcely pointed at tip. Arista dorsal, pubescent. Lower orbital cilia yellowish, slender.

Thorax green with bronze reflections, a little dulled with white pollen; there are no ante-alar black spots. Abdomen green with quite abundant white pollen. Hypopygium small, but little longer than thick, extending forward under the venter, black with green reflections; its outer appendages look like small yellow lameliæ (fig. 9) with black bristles, but they seem to be united at base as in the figure; the inner appendages are darker and rather small, they are deeply slit into three parts at tip.

Coxæ, femora and tibiæ yellow. Fore coxæ with black hairs on the inner edge of their anterior surface; middle and hind coxæ each with a long black bristle on outer side, the former darkened on the outside. Hind femora scarcely darker at tip above, their tibiæ more distinctly brown at tip. Middle and hind femora each with a slender preapical bristle, the former also has smaller ones below near the tip. Fore tarsi (Fig. 8) more than one and a half times as long as their tibiæ, first two joints yellow with their extreme tips blackish, second slightly longer than the first and very thin, it is about as long as the last three joints taken together; third and fourth joints black, compressed and widened, fringed above with little black hairs; fifth yellow with the base narrowly black. Middle tarsi longer than their tibiæ, black from the tip of the first joint. Hind tarsi equal to their tibiæ in length, wholly black, still sometimes the first joint is yellowish at base, first joint shorter than the second. Calypters and halteres yellow, the former with yellow cilia, which appears nearly black in certain lights.

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Wings (fig. 7) grayish; third vein bent backward at tip; last section of fourth vein bent at its basal third, approaching third, but bending back a little toward its tip so as to be parallel with third vein for its apical third and ending in the apex of the wing; last section of fifth vein twice as long as the cross-vein; anal angle of wing rounded but rather prominent.

Female: Like the male in general color and the form of the wings. The face is not very wide and is hollowed out almost to its lower edge; face and front wholly silvery-white, proboscis narrowly blackish on the edge, which is fringed with quite conspicuous black hairs. Ovipostor yellowish with a circlet of short, blunt spines at tip. Fore tarsi blackened from the tip of the first joint; their second joint about three-fourths as long as the first.

This female is easily recognized by its venation, together with the silvery front and yellow proboscis and ovipostor.

Described from many males and females. I took them in Williamsville, Erie County, N. Y., August 8 and 29, 1920. Mr. Burns took many at the Palisades, N. J., July 5, 1920.

Holotype and Allotype in the author's collection and taken at Williamsville, N. Y.

Those I took were flying around the surface of the water which was running over the rocks, and resting on the moss and rocks in the little falls, very much as does *Liancalus*. The very short hypopygium would almost separate this species from *Paraclius*, but it is entirely disengaged although sessil and extends a little under the venter.

Paraclius ovatus Van Duzee.

This is the same as *Paraclius venustus* Aldrich, and is therefore a synonym of that species. Dr. Aldrich reports it as abundant in the West Indies and Mexico. I have seen specimens from Georgia and Costa Rica.

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CICADELLA GOTHICA SIGN.—A CORRECTION.

By Geo. W. Barber,
U. S. Bureau of Entomology, Arlington, Mass.

In Vol. XXVII, page 147, 1920, of this journal, I have recorded the occurrence of *Cicadella hieroglyphica* (Say) from Massachusetts. The record was an error and was based on a determination submitted to me which, at the time, I had no reason for questioning. The insects recorded under this name are all *Cicadella gothica* Sign., as are all of a large number of specimens from New England at hand.

The confusing of these two species, which has so often happened, is further made possible by the discovery of a dark variety of *gothica* which resembles *Cicadella hieroglyphica,* var. *dolobrata* Ball very closely indeed. This variety seems to be undescribed, and as to its future collection may again lead to a confusion of these species, it may be well to characterize it at this time.

Cicadella gothica, var. *atra* var nov.

General structure and size of *gothica:* Shining black, markings on anterior half of vertex nearly as in *gothica,* except that the yellow area surrounding the black apex is narrowly produced posteriorly for a third the length of the vertex. The black markings on the posterior half of the vertex confused, so that this portion appears solidly black with some light points indicating the yellow markings of *gothica;* eyes irregularly margined with yellow; margins of clavus light. Beneath, black; tips of femora, tibiæ and tarsæ lighter; front, dark brown, median stripe tawny.

One male taken at Lexington, Mass., September 8, 1920.

This variety is distinct from any dark forms of the typical insect that I have seen, although dark individuals are not uncommon.

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SPIDERS FEEDING ON SMALL CYPRINODONTS.

By T. Barbour,
Museum of Comparative Zoology, Harvard University.

This spring was unusually dry in Southern Florida, especially during March and early April. Ponds were low and even the large lakes were considerably reduced in area. This condition may have influenced the habit which I observed and which Mr. Banks and Mr. Emerton have kindly suggested my recording.

While fishing for bass in the upper St. John River, above Lake Washington, where the river is a narrow, sluggish stream, I have always camped to cook my midday meal on a willow tussock in a shallow slough, which offers about the only chance to build a fire in this very boggy country. This year the water in the little bayou was low and the water hyacinths and lettuce plants usually afloat were resting with their roots on the mud in the shallows. The vegetation swarmed with Dolomedes, but then these spiders always seem to have a predilection for creeping about on the floating lettuce, especially. The water, both beneath the plants and in the little open spaces between them, teemed with several species of cyprinodont fishes, of which a Gambusia, beyond doubt affinis, was the most abundant.

After eating, I rested quietly awhile in the stern of my boat, which was partly hauled up on the tussock, hence quite motionless. A tiny flash of silver caught my eye, and I looked again, to see a spider carrying a small dead fish, perhaps an inch long, across a wide leaf to the dark interior of a large lettuce cluster. I thought that probably the spider had found a dead fish by chance, and I relit my pipe, when about six feet away in another direction the episode was repeated. This time the little fish was still struggling feebly in the spider's cheliceræ. Later I saw a third fish being carried off which was dead and quite dry. At the time I presumed that the habit of catching fish was probably well known and I thought no more about the happening until I spoke to my friends and searched the literature with small results.

McCook, in his "American Spiders and their Spinning Work," (Vol. 1, 1889, p. 236, fig. 219), pictures an enormous spider riding on the back of a moribund and gigantic carp, if the relation of

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the size of the fish to that of the surrounding lily leaves is normal. The accompanying story of the unique event is too flamboyant to be very convincing. Comstock (Spider Book, 1912, p. 186), offers no original observations but adds, "Several apparently well-authenticated instances of the destruction of small vertebrated animals, including birds, a mouse, a fish and a snake, by spiders that are much smaller than the Avicularia are given by McCook. But, of course, all such occurrences are exceptional." I presume that, given conditions such as I have described, small fish may offer an easy and frequent prey for spiders with the habits of Dolomedes. Otherwise the opportunity to secure such prey cannot be very frequent. The species involved I believe to have been *Dolomedes tenebrosus*.

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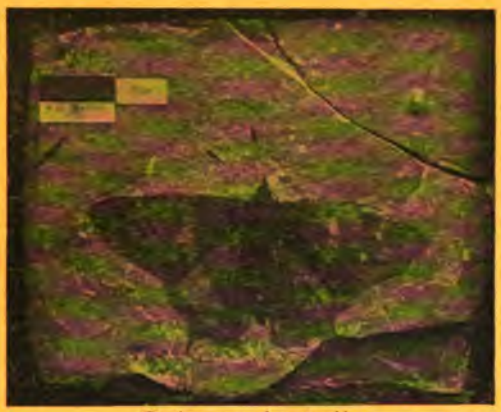

Prodryas persephone Scudder.

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VESPA ARCTICA ROHWER, A PARASITE OF *VESPA DIABOLICA* DE SAUSSURE.[1]

By W. M. Wheeler and L. H. Taylor.

The summer of 1921, at least in New England, was a "wasp summer," probably on account of the protracted, hot, dry weather during June and July. Certain species of *Vespa,* especially the common yellow-jacket, *V. diabolica,* were unusually abundant. Probably for this reason we were able to make the following observations on a rare wasp, *V. arctica,* which, as shown by Fletcher in a paper read before the Entomological Society of America (1908), is a parasite in the nest of *diabolica.* Unfortunately, Fletcher died before he could publish his paper, and the very brief notice of it in the proceedings of the Society is all that has appeared.

During the summer of 1921 the senior author spent his vacation at Colebrook, in the Litchfield Hills of Connecticut; the junior author at Forest Hills, near Boston. In both places a number of *diabolica* nests were examined, and in three of them *arctica* was taken. The latter species[2] is black and white, and in size and markings may be very readily mistaken for *V. consobrina* De Saussure, but closer examination shows that it has long cheeks and long hairs on the tibiæ. It lacks, moreover, the worker caste, and therefore differs from all known species of *Vespa,* except *austriaca* Panzer, which will be considered more fully in the sequel. This absence of the worker caste at once suggests that *arctica* is a social parasite like the species of *Psithyrus* in the nests of bumble-bees and certain ants (*Anergates, Epoecus, Epipheidole, Sympheidole, Anergatides,* etc.) in the nests of *Tetramorium, Monomorium* and

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 195.

[2] This species was originally described by Lewis (Trans. Amer. Ent. Soc. 24, 1897, p. 173) as Vespa borealis, but Rohwer (in Viereck, Hymenoptera, or Wasp-like Insects of Connecticut, 1916, changed the name to arctica, as Kirby had previously described a V. borealis (Fauna Boreali-Americana, 1837, p. 264).

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Pheidole. *V. arctica* belongs to the Canadian and Upper Transition zones. Sladen (1918) records it as ranging from Nova Scotia to British Columbia. It has been recorded from Amherst, Mass., according to Rohwer (Viereck, 1916), and by him included in the list of Connecticut Hymenoptera as probably occurring in that state. The senior author has taken it repeatedly but sparingly at Colebrook (1200-1600 ft.) during the summers of 1918 and 1919, on the flowers of *Spiræa salicifolia*. Until it was taken by the junior author at Forest Hills during the past summer, there was no record of its occurrence near sea-level and in Eastern Massachusetts.

The three observations that go to confirm Fletcher's contention that *arctica* is a social parasite in the nests of *diabolica* are the following:

1. On July 4, the senior author's attention was called to a *diabolica* nest attached to the bottom of the back-net of his tennis-court, at the surface of the ground, in a bunch of grass and sensitive fern. As the wasps were intimidating the players, the colony was asphyxiated after dusk on July 7 by throwing cloths saturated with carbon bisulphide over the nest. On removing the cloths on the following morning, the nest and its occupants were carefully examined. The structure had attained the size and shape of an orange about 12 cm. in diameter, and contained two broadly elliptical combs, a larger, upper, measuring 8 by 6.5 cm., and a smaller, lower, measuring 7 by 5 mm. There were 64 wasps in the colony, 62 workers of *diabolica*, a queen of the same species, and a queen *arctica*. The upper and older comb had two concentric circles of capped cells, enclosing pupating larvæ and pupæ. The open cells contained eggs and young larvæ of different sizes. Undoubtedly all the brood in this comb represented workers of *diabolica*. The lower comb (Fig. 1) had a single circle of 20 pupæ of *diabolica* on half its area, while the center of the other half was occupied by a clearly defined cluster of 11 very large, elongate cells, each containing a conspicuously large larva. These cells are marked with white crosses in the figure. The remaining cells were very small and short and contained eggs and very young larvæ. Evidently all or nearly all the brood, except the 11 large

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larvæ belonged to *diabolica*. These large larvæ, which were nearly ready to pupate, must have belonged to *arctica*, and were probably females. That they had been abundantly fed by the *diabolica* workers and their development favored beyond that of the remaining larvæ was evident from a glance at the two combs. Examination of the two queens, which were of the same size, showed that their wings were mutilated. The apical halves of both wings of the *arctica* queen on the right side had been bitten off. As both queens were still fresh when found in the nest on the morning of July 8 (the *diabolica* queen, when stimulated, still moved her tarsi!) we may infer that both were living together in the nest, though probably not on the best of terms, that the *arctica* queen had probably entered the nest just as the workers were beginning to build the second comb and had oviposited in 11 of its cells, and that the resulting larvæ were being actively fed by the *diabolica* workers, because the parasite's wings were too much mutilated to permit her to leave the nest and forage.

2. On June 29, the junior author killed a colony of *diabolica* which had its nest in the hay-scales of the State Antitoxin Laboratory on the grounds of the Bussey Institution. It was younger than the preceding, had one comb and only a few cells of a second, and contained only a small number of *diabolica* workers and an *arctica* queen. Since the colony was captured during the day, most of the *diabolica* workers were probably out foraging, and the absence of the *diabolica* queen may, perhaps, be accounted for on the same supposition.

3. August 4, the junior author took in the Arnold Arboretum a nest of *diabolica* containing three recently emerged males of *arctica*. In the same nest were about a dozen large larvæ and two or three pupæ, evidently queens, though whether of *diabolica* or *arctica* was not determined, as they were unpigmented. In all probability, however, they belonged to *arctica*. The presence of worker larvæ and pupæ indicated that the queens of both species were in the colony at about the same time (that is, if the time for development of *diabolica* workers is about the same as that required for the *arctica* males), and that at least one of the queens had been in the nest very recently was indicated by the numerous eggs, although these might, of course, have been laid by the workers.

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During the entire summer we sought carefully for additional nests of *diabolica* infested with *arctica,* but none was found. At Colebrook the males of *arctica* were not uncommon on the flowers of *Spriæa salicifolia* and *Pastinaca sativa,* usually during the morning or late afternoon hours in three different localities where infested colonies of *diabolica* must have been present but could not be located. The first of these males was captured as early as July 16, and a few were taken every few days throughout the remainder of July and the first two weeks of August. Thereafter the species seemed to have disappeared, though in previous years a few males and females were captured as late as September 1. No males of *V. consobrina* were seen on flowers till July 31, and virgin females and males of *diabolica* did not appear till later (August 20 to 22), and soon afterwards disappeared. It would seem, therefore, that the early emergence and long flying period of the *arctica* males is an adaptation to insuring the fecundation of the much less numerous females, an adaptation the more necessary because the species is very rare most summers, when the host species, too, is less abundant.

The foregoing observations have an important bearing on what has been learned concerning *V. austriaca.* This wasp, which also lacks a worker caste, has long been known in Europe, where it ranges from Ireland to Russia, with a marked preference for mountains up to an altitude of 5500 feet. It seems also to occur in Palearctic Asia. Recently Bequaert (1916) took two females of *austriaca* at Fort Lee, New Jersey, opposite New York City, and recorded a specimen taken by Prof. J. S. Hine on the same day (July 16) on Staten Island. More recently (1918) Sladen has taken *austriaca* at Ottawa and Chelsea, Quebec (mid-June), and at Winnipeg and Kaslo, British Columbia (mid-July), and Bequaert (1920), cites specimens from Savonoski, Alaska (July), Mt. Hood, Oregon (G. P. Engelhardt Coll.), and Beaver Mouth, Selkirk Mountains, British Columbia (J. C. Bradley Coll.). In Europe this wasp has been taken in the nests of *V. rufa* and has been regarded as a parasite of the latter by Morawitz (1864), Schmiedeknecht (1881), Robson (1898), Saunders (1903), Sharp (1893), Pérez (1910), and Bequaert. Carpented and Pack-Beresford (1903) have published a careful account of an *austriaca-rufa*

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colony taken in Ireland. They show that the two species are very closely related taxonomically, and infer that "the old *austriaca* queen was the foundress of the nest and that both the *rufa* and *austriaca* are her offspring." The evidence with which they endeavor to support this inference seems to us to be very inconclusive. It is indeed surprising that such accomplished entomologists should have failed to take account of the habits of other parasitic Aculeata, such as *Psothyrus* and the workerless ants, which are all so much better known than the wasps they werestudying.

The occurrence of *austriaca* in the vicinity of New York City and in British America and Alaska, at once raises the question as to its American host, since *rufa* is not known to occur on this side of the Atlantic. Bequaert surmises that *consobrina* may be the American host, and maintains that this wasp, "although very different in coloration, is very probably the American rase or subspecies of *Vespa rufa* L." If this proves to be the case, we should have the short-cheeked, black and yellow *austriaca* living with the short-cheeked, blach and white *consobrina,* just as our long-cheeked, black and white *arctica* lives with the long-cheeked, black and yellow *diabolica.*

The dates of flight of male and female *austriaca* and *rufa,* carefully recorded by British entomologists (Carpenter and Pack-Beresford and Evans (1903)), indicate that the *austriaca* queens issue from hibernation later in the spring than the nest-founding *rufa* queens. The same is probably also true of *arctica* as compared with *diabolica.* Hence the parasitic queens, when they first appear in the spring, find the host nests already well-established and containing a worker personnel ready to nurse the parasitic brood. The parasitic *Psithyri* show the same tendency to enter the *Bombus* colonies only after their first batch of workers has emerged (Sladen, 1912), and the parasitic ants take a similar advantage of their host species.

The presence of both host and parasitic queens in the *arctica-diabolica* nest examined by the senior author at Colebrook, raises the question as to the probable eventual fate of the host queen in infested nests. In the various cases of the mixed colonies among ants the host queen is soon eliminated, and, according to Sladen (1912), the same rule applies to the *Bombus* queens of colonies

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invaded by *Psithyrus* and to the queen of *B. terrestris lucorum* when its nest is invaded by the queen of *B. terrestris-virginalis*.[1] Had the Colebrook *arctica-diabolica* colony, which was still young when asphyxiated, been permitted to continue its growth and development, the *diabolica* queen might, of course, have been eliminated. This would, indeed, seem probable, if we may judge from the observations of Robson and Carpenter and Pack-Beresford on *austriaca-rufa* colonies, which were well-developed when examined. The colony observed by Robson had no *rufa* queen, but must have been founded by one, since typical *rufa* males were present. He saw the *rufa* workers dragging out of the nest the decapitated and mutilated carcass of an *austriaca queen*, presumably after her brood had been reared by the *rufa* workers. Thus it would seem that in this colony the host-queen had been killed either by her own workers or by the parasitic queen, and that the latter had been killed by the *rufa* workers or had died a natural death in the nest after completing her life-work. Carpenter and Pack-Beresford give a detailed census of their *austriaca-rufa* colony. It contained an old *austriaca* but no *rufa* queen, besides many males and three pupal queens of *austriaca*. In this case also, the host queen seems to have been eliminated earlier in the season.

The absence of the host-queen from nests infested by the parasitic wasps, as in the nests of *austriaca-rufa* just considered and the two *arctica-diabolica* nests found by the junior author, may be due, nevertheless, to quite other causes. Desertion of the nest by its foundress, even after brood is present, or her destruction while foraging, may leave the colony motherless and open to invasion by parasitic queens. Janet (1903) has even observel the invasion of a motherless *V. crabro* nest by a strange *crabro* queen, and her adoption by the workers. Both Janet and Marchal (1896) have failed to find the queen in several nests of this wasp, and the latter shows that in the case of *V. media* the queen is so short-lived that she completes oviposition by the beginning of August and disappears soon afterwards. The development of *media* colonies is, therefore, considerably accelerated as compared with the colonies

[1] This rule does not seem to apply to some of our American Psithyrus-Bombus colonies, to judge from the very interesting, unpublished observations made by Mr. O. E. Plath at the Bussey Institution during the past summer.

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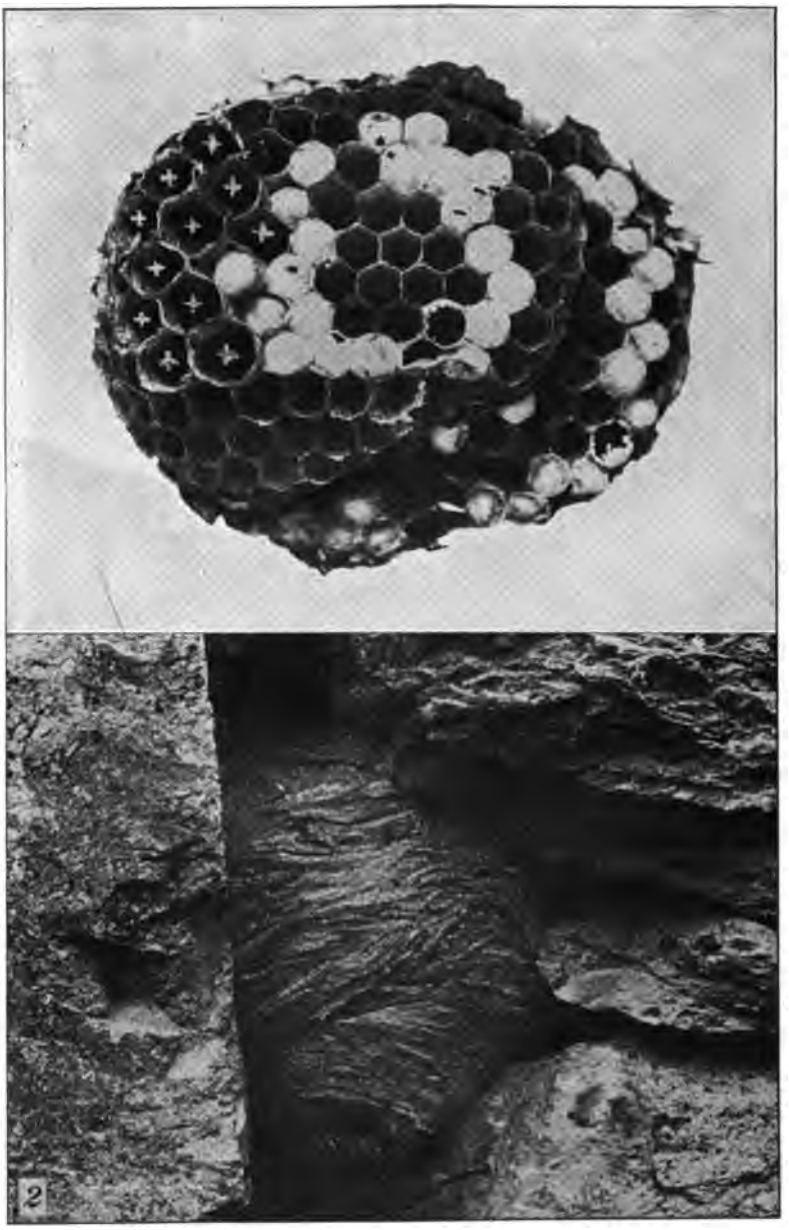

Wheeler & Taylor — *Vespa diabolica*

Fig. 1. Combs from nest of **Vespa diabolica** taken by the senior author at Colebrook, Conn. The white croses at the left mark the large cells occupied by the larvæ of the parasite, **Vespa arctica**. Natural size.

Fig. 2. Typical nest of **Vespa diabolica**. about 2/5 natural size.

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Fig. 3. Nest built by workers of **Vespa diabolica**. Natural size.

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of *V. germanica* and *communis,* in which the mother queen is often found as late as the last of September or early October.

Perhaps the *diabolica queen* may resemble the *crabro* queen in her tendency to desert an incipient nest and found another, or perhaps, as a rule, she may desert her nest as soon as it is invaded by an *arctica* queen. That she is short-lived, like the queen of *media,* seems to be indicated by the following observations on uninfested nests:

July 21, the senior author asphyxiated a *diabolica* colony which was nesting very near the ground at the base of a cluster of golden-rods in a deserted pasture. The nest was well-developed, with two large combs and a very small, four-celled third comb. There were 76 workers but no queen, although her presence might have been expected, since the colony was asphyxiated after dark.

August 27, the senior author found depending from the ceiling of a porch a small abandoned *diabolica* nest. It had only a single small comb, about 3.5 cm. in diameter, containing some dead worker pupæ and small larvæ. A similar deserted nest was found earlier in the season attached to the limb of a tree.

Also on August 27 a large, well-developed *diabolica* nest was found under the roof of a water-tank. Two living workers were still clinging to the involucre, which contained three well-developed combs. There were a few living worker pupæ in the combs and a number of dead workers that had fallen from the nest. The males and virgin females had departed, so that the colony must have completed its development several days and possibly a few weeks before the first of September.

Of eight *diabolica* nests taken by the junior author before August 4, on the grounds of the Arnold Arboretum, only one contained an old queen, although in each case care was taken to secure the entire colony.

A flourishing colony of *V. diabolica* comprising 200 to 250 workers, also without a queen, was taken August 10. The apparently exclusive emergence of males from this colony, as a result of which there were scarcely 25 workers left in the nest by Sep-

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tember 10, suggested that the queen might have been absent for some time before the earlier date.[1]

Of two *diabolica* nests taken September 14, one contained approximately 150 workers and 250 males, though the colony must have numbered fully a thousand during its prime. This nest had no queen, but in the other one killed the same day, along with 40 workers and 60 males, was a single virgin female, the last of a considerable number that the colony had produced.

Our observations on *V. arctica* and *diabolica,* though fragmentary, seem to justify the following conclusions:

1. The nest-founding queen of *V. diabolica,* like that of the European *media,* is rather short-lived, completing oviposition and perishing rather early in the season, probably not later than the middle or early part of August, at least during favorable summers.

2. There are some indications that the *diabolica* queen, like the *crabro* queen, has a tendency to desert her nest in an incipient stage and found another.

3. *V. arctica* is a permanent social parasite in the nest of *diabolica,* and her brood, consisting exclusively of males and fertile females, is reared by the *diabolica* workers.

4. The over-wintering queen of *arctica,* like that of *austriaca,* probably appears late in spring, at a time when the nests of the host-species are already established and contain enough workers to nurse her brood.

[1] In taking this nest at dusk the junior author failed to capture about a dozen workers which were still flying about, and which finally settled on the tree from which the nest had been cut. Deprived of their habitation, and even of the branch which supported it, these few workers were huddled together the next evening at a place remote from the original position of the nest. Closer observation revealed that they had already attached bits of newly-made paper to the bark of the tree. It was about this paper that the workers were congregated. By the end of the second day the wasps had suspended a single cell from a strong filament of paper after the manner of a queen in founding her nest in the spring, and in a few more days the structure had begun to assume the proportions of a normal nest. On September 10 it was about the size of a hen's egg and there were still two or three workers defending it (Fig. 3). Six days later this nest was found torn open, apparently by a predator, perhaps a bird, which had robbed it of whatever it might have contained, thereby preventing further observation.

The construction of nests by workers of European species of wasps has been observed by several authors, notably Janet (1903), who describes three new nests built successively by workers of the same colony. Other accounts are given by Ormerod (1859), Stone (1860), von Siebold (1871), Kristof (1878) and Marchal (1896).

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5. The fate of the host queen in such nests is unknown. Whether she voluntarily deserts the nest soon after the parasite enters or is killed by the latter or by her own workers, or whether the parasitic queen has a tendency to enter young motherless nests of the host species, remains to be determind. That both queens may occasionally live side by side for some time, would seem to be demonstrated by the colony examined by the senior author.

6. From what is known of *V. arctica* and *austriaca* we may conclude that these workerless wasps have essentially the same relations to their host-colonies as the parasitic *Psithyri* and workerless ants (*Anergates*, etc.).

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NOTES ON DEFENSIVE SCENT GLANDS OF CERTAIN COLEOPTERA.

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The attention of the writer was first directed to the functions of defensive or repugnatorial scent glands in certain Coleoptera during the study some time ago of the biology of some of the more common species of Coleoptera belonging to the Tenebrionid tribe Eleodini, inhabiting portions of the central Great Plains region. Later, a growing interest led to closer field observation and to the examination, as opportunity offered, of available literature on the subject. The notes which follow are intended merely to supplement data already published, to which reference is made.

It is obvious to anyone at all familiar with insect life, that the degree of sensitiveness and response in insects to certain external phenomena is enormously greater than in vertebrates, and that their organs of sense are developed accordingly. It always has been a cause for wonder to human beings as to the means by which the various lower animals recognize, distinguish and communicate with each other. Although we know very little about the senses of the lower animals, it long has been known that such senses as sight or touch are not nearly so important to insects as to us. We know that insects actually do distinguish and communicate with each other, or are attracted or repelled by each other, and as the means of communication are not known to use, may we not safely assume that such is brought about through factors, the existence of which is not yet recognized or understood? Packard (1898) has called attention to the ease and rapidity with which exceedingly delicate, attenuated, and highly volatile odors unknown to us are perceptible to insects. McIndoo (1917) has suggested the presence of a chemical sense or senses, somewhat comparable to our olfactory sense, which receives and transmits stimuli in a way somewhat like that of odors, and has ably discussed the results of observations and experiments upon certain insects, and has given a short historical review of the literature on the subject. In fact,

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the subject as a whole in its relation to animal ecology makes a powerful appeal to the human imagination.

It has been well understood that the presence of defensive or repugnatorial scent glands in certain insects exists in direct adaptation to the needs and habits of their owners and in close response to their environment; also that such glands are of very frequent occurrence and with much variation as to position, form, and function; and that their presence is of value to the insect for repellent, defensive, and warning purposes. These eversible glands most frequently occur in the form of simple hypodermic pouches from which can be emitted, when desired, varying amounts of an odorous spray capable of permeating throughout considerable surrounding atmosphere. Biologically speaking, the principle involved in such cases, though often modified, is practically identical with that of the mephitic, sulphuretted, oil-like fluid ejected by the skunks. Thus far anal glands are known to be present in the following families of Coleoptera: Cicindelidæ, Carabidæ, Dytiscidæ, Gyrinidæ, Staphylinidæ, Silphidæ, and Tenebrionidæ. The blood itself serves as a repellent fluid in the Meloidæ, and in the Coccinellidæ and Lampyridæ, and it issues from a pore at the end of femur as a yellowish fluid. The cantharidine in the blood of some species of Meloidæ, commonly known as "Spanish Fly," forms an especially caustic protection against birds, predaceous insects and reptiles. A number of the Carabidæ eject from a pair of anal glands a pungent, acid, and often corrosive fluid, staining the hands a rust-red color, and in *Galerita janus* Fab., the "Bombardier beetles" (*Brachinus*), and others, it "explodes" or volatilizes as soon as it comes in contact with the air, and the discharge and puff of vapor is accompanied by an audible report. This occurrence may be repeated over and over again in succession at frequent intervals. Westwood (1839) has recorded that specimens of a *Brachinus* of large size from South America, when captured "immediately began to play off their artillery, burning and staining the flesh to such a degree that only a few specimens could be captured with the naked hand, leaving a mark which remained for a considerable time." The odor of rose or hyacinth given out by certain Cicindelidæ, or the fragrance exhaled by the European *Aromia moschata,* are secretions probably formed by similar glands.

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The larvæ of certain Coleoptera, notably in the Chrysomelidæ, also are supplied with eversible hypodermal glands of various kinds. Folsom (1906) states that "the larvæ of *Melasoma lapponicum* evert numerous paired vesicles which emit a peculiar odor."

Packard has divided all scent-producing organs into repugnatorial and alluring organs, and a third class including those for recognition only, has been suggested by McIndoo, who has directed attention to the fact that it often is impossible to determine purposes for which such organs are used.

During the summer and fall of 1914 and the spring of 1915 collections of various species of adults of Eleodiini for breeding purposes, aggregating several thousand specimens, were made by the writer over a considerable area in Western Kansas and Western Nebraska, and during this period there were many opportunities for making observations relative to a curious habit possessed by many members of that tribe. When disturbed, many of them have a habit of standing on their anterior and middle legs, elevating the abdomen to its utmost height, appearing at times fairly to stand upon their heads, and spurting sidewise right and left from their eversible repugnatorial glands, a persistently malodorous liquid having a peculiar penetrant odor, and capable, when brought into accidental contact with the skin of the human hand, of making a stain almost impossible to wash off, and the odor of which varies in intensity with some of the species.

"The smell of the glandular secretions," says Gissler (1879), "is to my knowledge incomparable to anything else." The glands of the species examined, *Eleodes gigantea* Mann., are in both sexes embedded in the fat bodies on each side of the intestinal tract, and consist of two reddish-brown organs about 6 mm. in length, somewhat cylindrical at one end and roughly flattened at the other. Gissler has records concerning the fluid that "When the secretion is spurted on a glass slide, it solidifies within a few seconds, forming an orange-colored magma of minute crystals, in other cases it only partially crystallizes, and in others it remains entirely liquid. It is in all cases of an acid reaction, and of an intensely penetrant odor, causing the eye to lachrymate. It is soluble in water, alcohol and ether. Boiled with concentrated sulphuric acid and alcohol an ethereal aromatic vapor is produced, indicating the

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presence of one or more organic acids. . . . Having tested for valerianic acid in the usual way with neutralized soda solution upon sesquichloride of iron, no red precipitate of valerianate of iron was formed, nor have I obtained a bluish-white opalescent liquid of butyrate of copper on adding acetate of copper. Uric acid was also found to be absent, on treating with nitric acid and ammonia in the usual way; neither could I detect formic or acetic acid, nor did boiling with caustic soda liberate ammonia. A few drops of the secretion, put on a piece of dry caustic soda, turned at first dark green, became in a few seconds dirty brown, and cleared up to a brownish red after several hours."

It was interesting to note that the quantity of the secretion voided varies noticeably with the different species under observation, both under field and under laboratory conditions, and some of the species, notably *Eleodes tricostata* Say, undoubtedly have the habit of erecting the abdomen in a threatening manner when approached, though no secretion may be voided. Such species undoubtedly find protection through imitation of the threatening movements of their more formidable associates. Two of the characteristics of the Eleodes are their slowness of movement, and their habit of coming out of their hiding places about sunset for feeding purposes, and their presence is readily noticed on the bare sandy plains by birds, skunks, and other enemies, hence their protective secretion, or, in the absence of this, their threatening maneuvers are no doubt of highest value to them.

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A NEW SPECIES OF HETEROCAMPA (LEP., NOTODONTIDÆ.)

By Wm. Barnes, M. D. and A. W. Lindsey, Ph. D.
Decatur, Ill.

Heterocampa amanda n. sp.

Head, thorax and abdomen light gray or brownish gray to dark gray. Tufts and tips of patagia darker. Pectinations of ♂ antennæ long, gray-brown; shaft with some light gray scales.

Primaries gray, the costa powdered with whitish scales and the veins in part somewhat darker than the ground color. Within the basal area, below Cu_2, and beyond the cell there are sometimes paler, somewhat brownish areas. Basal line geminate, the outer black, the inner gray, and the included space buff. T. a. line geminate, faint, outwardly convex between the veins. This line is oblique, almost reaching the middle of the inner margin, and is slightly curved. T. p. line similar but with scallops reversed and much slighter. This line is almost upright, but is slightly concave outwardly beyond cell and inside of Cu_1, leaving the usual square projection between Cu_1 and M_3. The s. t. line is made up of two blackish shades, one almost straight from near apex to M_3, the other beginning outside of the first on M_3, running thence to Cu_2, and then curving outward toward the anal angle. Both are followed by vague slender whitish lines. There is a blackish terminal line, sometimes cut by white on the veins, and the fringes are concolorous with the wing, but with blackish at the veins. Cell terminated by a curved blackish line. Secondaries white in male, the costa, outer margin (very slenderly), terminal quarter and sometimes a short median portion of veins marked with gray-brown. Fringes more or less grayish, darker at the veins. In the female the secondaries are more gray-brown with a variably definite band filling the terminal third and a less strongly marked median shade and discal spot. Fringes grayish white, dark at the veins. Under surface white in the male, the secondaries marked much as above and the primaries darker toward costa and apex, with only the markings of the fringes, a discal bar, and sometimes a paler terminal area visible. In the female this surface is much darker, as would be expected. The primaries are otherwise similar

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to those of the male, while the secondaries have a terminal powdery whitish area, preceded by a broad vague transverse shade and then by a slender median shade, both of which lose their identity toward the costa. The discal bar is present. Expanse 35 to 45 mm., the sexes similar.

Described from ten specimens in coll. Barnes. Holotype ♂, 3 paratypes ♂ and one paratype ♀, from the Hualapai Mts., Mohave Co., Ariz., May. One paratype ♂ from the Planet Mine, Bill Williams R., Yuma Co., Ariz., and four paratypes ♀ from Mohave Co., Aug. In addition we have specimens from Yavapai and Cochise Counties, Ariz.

We place this species after *umbrata* Wlk. and its forms, though it is not closely related. Its superficial appearance suggests *Fentonia miranda* Dyar, but it is a true *Heterocampa* and this resemblance is only general.

NOTE ON THE SURGONOPODS OF CERTAIN MECOPTERA AND NEUROPTERA.

By G. C. Crampton.

Through the kindness of Mr. A. N. Caudell, I have recently been able to examine a specimen of the interesting Mecopteron *Merope tuber,* preserved in alcohol. Since the specimen was preserved in fluid, this permitted the moving of the parts without danger of breaking them, and enabled me to determine that the parts which I formerly considered to be the dorsal penis valves (i. e., the parts labeled "dv" in Fig. 24, Plate III, of Psyche, Vol. 25, 1918), from an examination of a dried specimen of *Merope* in the Cambridge museum, are in reality the surgonopods, or lateral appendages of the tenth abdominal segment. It would also appear that certain of the structures called gonopods in the Neuroptera shown in Figs. 14, 12, etc., of the article in question, are likewise homologous with the surgonopods, as I have pointed out in a paper which will later be published, dealing with the terminal structures of insects in general.

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NOTES ON *ORCHESTES RUFIPES* LEC., IN NEW JERSEY.

By Harry B. Weiss and Ralph B. Lott,
New Brunswick, N. J.

According to Blatchley and Leng[1] this weevil is known to occur in New York, Vermont, Massachusetts, Newfoundland and Quebec. At Batavia, N. Y., according to H. H. Knight, it was abundant on the shining willow *Salix lucida,* the adults feeding on the leaves, July 1 to 15, the larvæ mining the leaves in August and September; other species of willow in the same locality were not infested. Gibson[2] states that in Ontario an outbreak of *rufipes* occurred locally on willow toward the end of May and during the first half of June at the Experimental Farm; beetles were first noticed on the laurel-leaved willow *Salix pentandra* on May 31, and were quite numerous by June 15, and their work noticeable. In one leaf, two and one quarter inches long and one inch wide, 329 feeding holes were counted. The species is not recorded in Smith's List of the Insects of New Jersey, although it is known to occur on *Salix lucida* and also on black willow *Salix nigra,* at Rutherford, where all of the observations recorded in this paper were made.

In New Jersey the beetles go into hibernation about the latter part of September and first of October, selecting such places as under loose bark, in partly dead wood, in dry stumps of limbs, etc. Here they may be found in colonies of varying numbers, depending on the size of their hibernation quarters. If suitable weather prevails a few beetles will emerge about the middle of April or even before and can be found crawling over the bark. Feeding soon takes places and by the last of April and first of May noticeable damage is being done to the leaves. Even at this early date many leaves will be brown and dry if the beetles are numerous. Feeding continues all during May, interrupted by copulation during the latter half of this month. Eggs are deposited during the last of May and first part of June, and by the middle of June hatching is under way and small mines are visible. By the last of June the mines, together with the larvæ, are good-sized and much in

[1] Rhynch. N. E. Amer., p. 282, 1916.
[2] 41st Ann. Rept. Ent. Soc. Ont., p. 15, 1910.

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evidence. Practically all of the adults disappear by the middle of June. The mining of the foliage continues until about the end of the first week of July, at which time most of the larvæ are full grown and pupation is starting. This takes place within the mine, requiring about a week or ten days. By the middle of July many beetles are out and by the last of July the entire brood is in evidence, feeding on such green foliage as escaped the ravages of the larvæ and the hibernating brood of beetles. Feeding continues until cool weather forces the beetles to seek winter quarters.

As has been stated before, a noticeable browning of the foliage starts about the last of April or first of May. As the feeding increases so does the injury, and by the time the mines are starting much of the foliage is brown and dead. The larvæ complete the destructive work, and by the end of July infested trees have the appearance of having been swept by fire.

The adult eats a hole usually through the lower epidermis and then consumes the tissue and juices between the upper and lower epidermis for a short distance around the original opening. This results in a little circular or oval hollow area in the leaf along the inner edge of which is the opening through which the beak was inserted. Later, the lower epidermis over the hollow space dries and falls off. This leaves a depression on the under surface. Still later the upper epidermis over the eaten portion becomes brown, dries and cracks, and this may result in a hole through the leaf. The injury really consists of a skeletonizing of the leaf from the lower surface, but it is not accomplished directly as in the case of most skeletonizing by other species. In severe infestations the feeding punctures are so close that the entire leaf is covered by them.

The eggs are inserted singly anywhere under the lower epidermis in irregular oval cavities, which resemble feeding punctures. The tissue above and below the egg becomes brownish. The female cuts nearly a complete circular slit in the lower epidermis, leaving enough tissue for a hinge. This circular flap is pushed to one side and an irregular oval area cleaned out. This results in a somewhat oval cavity with the opening at one end. The egg is then inserted and the flap closed. Eggs were found in young and old leaves, even when they were considerably injurd by feeding.

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The completed mines are blotch-like and usually extend from the midrib to the edge of the leaf, occupying from one-sixth to one-fourth of the entire leaf surface. They are visible plainest from the upper surface, where they appear as brownish, discolored, dead areas. As a rule, there is only one larva in a mine, but in many cases the mines merge, so that the entire leaf consists of a solid mine containing numerous larvæ. Many leaves contained from seven to twenty-two small mines. On account of the merging of some of these, and on account of the death of some of the partly grown larvæ, only from three to five completed large mines were found in most of the leaves at the end of the season.

Egg. Length, 0.32 mm. Width across middle portion, 0.2 mm. Oval, ends broadly rounded; translucent, somewhat whitish.

Larva. Length about 3.7 mm. Width of thorax about 1 mm. Form subcylindrical, thoracic segments wider than abdominal ones, body tapering slightly from thorax to posterior portion of abdomen. Segentation distinct. Whitish except for a median dorsal and ventral row of abdominal spots, the head and thoracic shield which are brownish (young larvæ is greenish-white, translucent). Head small, subcircular, sparsely hairy; collum absent; epicranial halves separated dorsally by faint median suture; front large, triangular; gula membraneous, indistinct; mouth parts small. Labrum triangular with truncate apex, anterior edge fringed with chitinous hairs. Mandibles broad across basal three-fourths, apical fourth narrow, acute, entire. Labium transverse with mentum and submentum fused, indistinct, anterior edge arcuate. Maxilla fused with labium to near apex, lacinia simple fringed with chitinous hairs on inner distal surface; maxillary palpi two-jointed. Thoracic shield transverse, covering most of prothoracic dorsum. Mesothorax and metathorax wider than all other segments. Sides of thoracic and abdominal segments produced laterally. True legs absent. Cerci absent. Anal segment wart-like. Body hairs short and sparse, more apparent laterally.

Pupa. Length about 2.6 mm. Oval, white to brownish black. Posterior dorsal portion of prothorax bearing prominent chitinized hairs, a transverse row of ten arising from dark, tuberculate bases, five on either side of middle. Dorsal posterior portion of abdomen terminated by a pair of upward-directed, stocky tubercles, tipped

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with sharp chitinous points. Dorsal surface of abdomen and metathorax bearing a few minute hairs. Head and snout bearing several chitinized hairs. A single prominent chitinized hair arising from distal portion of each femur. Wing cases with longitudinal striæ. Each abdominal segment with a pair of dorsal foveolæ, one on either side of the middle.

ADULT. *Orchestes rufipes.* This was described by LeConte in 1876 (Proc. Am. Phil. Soc. Vol. XV, No. 96, p. 208) from Vermont specimens. The original description follows:

"Black, very thinly pubescent, with fine whitish hairs; beak finely punctured, head punctured, front narrow but distinct; prothorax finely punctured; elytra oval, rather flattened, deeply striate, interspaces rugosely punctulate. Antennæ and legs yellow, hind thighs dusky, very slightly incrassated; funicle six-jointed, second joint scarcely longer than the third; thighs not toothed; claws broadly appendiculate. Length 2 mm.; .08 inch."

Should it be desirable to control this insect, spraying with arsenate of lead is recommended. The poison should be applied to the lower leaf surfaces during the last of April or first of May. On account of the length of time during which the adults feed before depositing eggs, almost complete killing should be accomplished.

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NOTES ON NOCTUIDÆ WITH DESCRIPTIONS OF SOME NEW SPECIES (LEP.).

By Wm. M. Barnes, M. D. and A. W. Lindsey, Ph. D.,
Decatur, Illinois.

Agrotinæ.

Prochloridea madonna n. sp.

Head and thorax clothed with a mixture of gray, whitish and mixed hairs and scales. Palpi dark gray outside, whitish within. Antennæ ciliate in the ♂. Abdomen shining grayish, touched with clay yellow.

Primaries with vestiture mixed black, whitish and gray scales in about equal parts, with two broad, light brown stripes radiating from base of cell toward apex and oval angle respectively. These stripes are sometimes scarcely visible, but are usually quite evident. T. a. line irregular, oblique, with a prominent tooth in costal region, one on cubital stem and one on anal vein; usually very vague but someties well marked; single, pale gray, marked on costa by one or two blackish dots. T. p. line also pale gray, preceded by a fine dark shade, outwardly curved around end of cell and rather even except on this bend, where it is finely dentate; near the inner margin it curves basad. Orbicular and reniform very vague, sometimes evident as dark central spots surrounded by pale margins. In the terminal space there is a variable number of short longitudinal black dashes between the veins. Fringes with alternating light and dark patches of a "pepper and salt" appearance similar to the primaries. Secondaries white with a slight sprinkling of dark scales in the outer third, usually localized on the veins, and a similar terminal line. Fringes white with a few dark scales. Female similar. Expanse 31 to 33 mm.

Holotype ♂, allotype, 13 paratypes ♂ and 3 paratypes ♀ from Olancha, Inyo Co., Cal., June 8-30, July, Aug., in coll. Barnes.

Madonna is smaller and more grayish than the three females in the type series of *modesta* B. & McD., and the median line of the secondaries is very rarely suggested. In spite of these differences we should not be surprised to find that it is only a race of the

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older species. Unfortunately the lack of males of *modesta* prevents our checking their relationship by an examination of the genitalia.

Lygranthœcia meskeana and **rufimedia** Grt.

These species are treated as synonymous in Smith's "Synopsis of the North American Heliothinæ" (Trans. Am. Ent. Soc. X, 235) and the latter is regarded as an aberration of the former by Hampson (Cat. Lep. Phal. B. M. IV, 65). We have recently had reason to consider these species, and find that the shades of the upper surface are so variable as to be confusing. On the lower surface, however, the pale areas are decidedly yellowish in *rufimedia,* but whitish in *Meskeana.* This difference appears to occur irrespective of sex or locality, and seems to be the most convenient criterion for the separation of the two.

HADENINÆ.

Lasionycta perplexa Sm.

This species is listed in the genus *Lasiestra* Hampson, which is characterized in the original description as having thoracic vestiture of rough hair. *Lasionycta* Auriv., on the other hand, is said to possess thoracic vestiture of hair and hair-like scales. The vestiture of *perplexa* is distinctly scaly and much less rough than in the other North American species which we retain in *Lasiestra,* and we therefore advocate its transfer to *Lasionycta.*

Nephelodes mendica n. sp.

Head and thorax with pinkish-brown vestiture, the hairs pale tipped. Abdomen more grayish with the usual clay-colored tinge.

Primaries similar, sprinkled with blackish scales along the veins. Median area filled with brown from radial stem to inner margin. T. A. line pale, oblique, vague. T. P. line sinuate, geminate, formed of a rather broad pale line preceded by a fine, dark shade, and very slightly crenulate. Orbicular and reniform variable in shade, in the holotype pale, with a few darker scales in the center. In one of the paratypes these spots are scarcely differentiated, except the outer part of the reniform, which is pale, and in the other they are concolorous, margined with darker scales. Median shade dark, vague. S. T. line faintly indicated by a contrasting dark shade, which is most noticeable in the costal region. Fringes

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concolorous, with paler bases. One paratype is much paler and more evenly colored than the other specimens and has a series of terminal dark dashes. Secondaries white, veins darker; terminal area sparsely sprinkled with dark scales; fringes white. Expanse about 40 mm.

Three males from Eureka, Utah (Spalding): holotype Sept. 21, paratype Sept. 21, and paratype Aug. 24, in coll. Barnes.

This species appears to be most closely related to *pectinata*, and we place it at the head of the genus. The peculiar shade of brown, less smooth vestiture of primaries, and white secondaries, separate it readily from *pectinata*.

ACRONYCTINÆ.

Langona, gen. nov.

Proboscis aborted; palpi small, weak, slender, slightly drooping, not quite reaching front. Front smooth, without projection; eyes large, rounded. Antennæ of male bipectinate, the pectinations ciliate; of female lightly ciliated. Head and thorax clothed with scales with a few hairs intermixed, metathorax with a large tuft of spatulate scales. Pro- and mesothorax without tuft (?). Legs moderate; tibiæ without spines or claws. Abdomen without tufts. Primaries with costa long, nearly straight; apex rounded-acute, outer margin strongly oblique, bent at Cu, secondaries relatively small, apex broadly rounded; outer margin bent between Cu_1 and M_3; anal angle broadly rounded. Vein Cu_1 of primaries near end of cell; Cu_2 about 4/5 from base; R_4 and R_5 stalked, anastomosing with R_3, out of R_2, to form areole. Cu_1 and M_3 of secondaries contiguous at base; M_2 obsolescent, from middle of discocellulars; M_1 and R_5 short-stalked.

Type: *Langona grisescens* n. sp.

Langona grisescens n. sp.

Head badly rubbed in type; apparently clothed with gray scales. Thorax badly rubbed in ♀, slightly so in ♂'s; vestiture of pale gray scales tipped with blackish, and with a few hair-like scales of the same color. Metathoracic tuft of whitish scales with the broad tips blackish, shining. Abdomen with pale brownish-gray vestiture. Primaries with gray scales tipped with blackish-brown and sprinkled with white scales in costal and apical half, giving the

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wing a hoary gray appearance. Transverse lines blackish; basal line from costa to anal vein. T. a. line oblique, bent outward before anal vein in the ♂, straight in the ♀; t. p. line bent outward below costa, where it is merged with a dark subapical shade, and more broadly in the median area, whence it curves inward to the inner margin, where it is followed by a small pale area. Subterminal area powdery gray; a fine, dark terminal line. Fringes concolorous. Reniform faintly indicated in all types and orbicular in ♂'s pale, with a darker edge. Secondaries powdery brownish-gray, paler at base. Fringes paler. Under surface of primaries even gray-brown with the sub-apical shade set off by some white powdering. Secondaries paler than above; terminal area and a discal spot darker. Expanse 24-27 mm.

Holotype ♂, Palmerlee, Ariz., allotype, S. W. Ariz., and paratype ♂, Hereford, Ariz., in coll. Barnes.

The species looks not unlike an Acopa, but is quite distinct from that genus.

Mominæ.

Although no members of this sub-family have yet been reported from our limits, we think that it must be accorded a place in our lists for the reception of Grote's genus *Trichocosmia* and both of the included species, *inornata* Grt. and *drasteroides* Smith. In both of these species the eyes are sparsely hairy and vein M_2 of the secondaries is very evidently nearer to M_3 than to M_1. They run to this subfamily in Hampson's key to the subfamilies of Noctuidæ (Cat. Lep. Phal. B. M. IV, 3 and 4).

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ON *EUMENES ALLUAUDI* PEREZ, A PRECINCTIVE WASP OF THE SEYCHELLES (HYMENOPTERA).

By J. Bequaert,
American Museum of Natural History, New York City.

In my Catalogue of Ethiopian Diplopterous Wasps, published in 1918,[1] I have attempted to correlate the various described forms of African *Eumenes*. In many cases, where specimens were not available for study, my conclusions were based on such inferences as could be made from published accounts, and were therefore only tentative. *Eumenes alluaudi* J. Pérez,[2] for instance, I regarded at the time as one of the color variants of *Eumenes lepeleterii* Saussure, to which it was said to be related by the author of the species. Through the courtesy of Mr. A. S. Rohwer, I recently had opportunity to examine a series of specimens of *E. alluaudi* in the U. S. National Museum collection, and was surprised to find that this wasp is structurally very distinct from any of its congeners. Since it apparently is restricted to a very small range in the Seychelles and neighboring islands, and thus affords a typical illustration of the effects of oceanic isolation upon the appearance and preservation of specific characters, it may be useful to redescribe the form and to figure some of its most noteworthy peculiarities.

Female. Length (head+thorax+tergites 1+2) 21 mm.

Decidedly more slender than *E. maxillosus,* strikingly so in the abdomen. Head (Fig. 1*b*) from front view about as high as broad, due to the lengthening of the clypeus. Clypeus distinctly higher than broad; its apical free portion a little longer than its basal part and with more deeply concave sides than in *E. maxillosus;* its apical margin almost straight, slightly curved inward, with pronounced, but blunt lateral angles. Vertex without fovea. Eyes bare. Posterior ocelli about as far from each other as from the eyes. Mandibles shaped much as in *E. maxillosus;* long and slender, beak-like, the inner margin with three slight notches; near the base of the inner margin an indication of the raised fold which is so prominent in the male. Antennæ and mouth-

[1] Bull. American Mus. Nat. Hist., 39, 1918, pp. 274-283.
[2] Ann. Soc. Ent. France, 64, 1895, p. 206.

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parts as in *E. maxillosus*. Shape and structure of thorax and legs also as in that species. Middle tibiæ with one spur. Abdomen more slender than in *E. maxillosus*, though of the same general shape. The basal, narrow portion of the petiole is fairly parallel-sided and about as long as, or but little shorter than, its apical, broadened part; the spiracles are prominent, placed a little beyond half the length of the petiole; the broadened, posterior portion

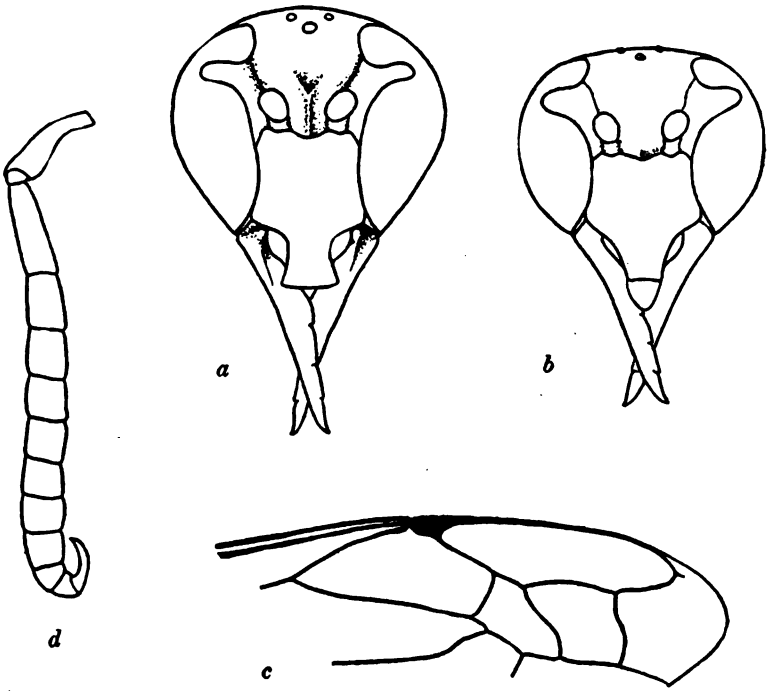

Fig. 1. Eumenes alluaudi J. Pérez. a, head of male in front view; b, head of female in front view; c, part of fore wing; d, antenna of male.

is nearly parallel-sided, but it has expanded apical angles as in *E. maxillosus*. In profile the posterior, broad portion of the petiole is less swollen and slopes more gradually toward the hind margin than in *E. maxillosus*. Second abdominal segment also more slender than in that species, with simple hind margin; its sternite regularly convex, but little if any flattened in the middle, never saddle-shaped. Fore wing (Fig. 1*c*) with the third cubital cell

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much longer than in *E. maxillosus;* on the radial cell it is slightly shorter than high and about the length of the second cubital cell on the cubitus.

Punctation mainly as in *E. maxillosus.* The clypeus, however, is not dull and feebly shagreened as in that species, but shiny, varnished, with hardly any sculpture that can be discerned with a hand lens, except for a very few, scattered, minute dots toward the sides. The thorax is also somewhat more finely sculptured than in *E. maxillosus.* Pubescence a little more abundant than in that species, especially on the under side of the abdominal petiole.

Black, abundantly marked with chrome-orange (nearest orange rufous of Ridgway's color nomenclature). Head almost entirely chrome-orange, with the exception of the inferior margins of the eyes at the extreme base of the mandibles, the posterior half of the temples, the occiput, the vertex, and the emargination of the eyes, which are black. Antennæ orange-yellow, somewhat darkened above. Thorax chrome-orange; mesonotum black, except for a narrow, comma-shaped orange spot placed on each side of the middle line, close to the pronotum; most of the thoracic sutures more or less tinged with black. Legs chrome-orange. Abdominal petiole chrome-orange, except at its base, which is black. Remainder of the abdomen velvety pitch-black, except its last sternite, which is more or less ferruginous. Wings almost uniformly smoky, with a strong purplish effulgence.

Male. Length (head+thorax+tergites 1+2) 23 mm.

Differs from the female only in the secondary sexual characters. Clypeus much higher than broad, of a very peculiar shape (Fig. 1*a*): its basal portion is nearly rectangular and somewhat longer than its apical, free part; the latter forms a rectangular, projecting plate, abruptly narrowed from the basal portion and slightly widened at its feebly convex or nearly straight, apical margin; the lateral angles of the apical margin are blunt but prominent, bearing short, raised ridges. The inner margin of the mandibles has, near its base, a strongly raised, somewhat tuberculate fold. Antennæ (Fig. 1*d*) much as in the male of *E. maxillosus;* their last, hook-like joint intermediate in shape between that of *E. lepeleterii* and *E. caffer,* being long, almost uniformly thick for the greater

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part of its length, feebly and gradually thickened toward its base, rather rapidly pointed at its apex, which is sharp and feebly curved; it can be folded into a small, deep, rounded pit at the extreme base of the under side of the tenth joint. Abdominal sternites three to seven more abundantly hairy than in *E. maxillosus*.

General coloration as in the female, but the posterior half of the petiole of the abdomen dorsally with a broad, heart-shaped, black mark (a black triangle with the apex directed posteriorly and the anterior base deeply emarginate). The last three abdominal sternites more or less ferruginous.

This species is evidently allied to *E. maxillosus,* but the male possesses such striking morphological peculiarities that it cannot be regarded as a color race of that species. I have been unable to find any close relative among the many species of *Eumenes* known from the Oriental and Indo-malayan regions.

The five females and two males seen by me are all colored much alike and come from the following localities: Mahé Island, Seychelles, 3 ♀ ♀; Seychelles, 1 ♀ and 1 ♂; Glorioso Islands, 1 ♀ and 1 ♀. All collected by Dr. W. L. Abbott.

E. alluaudi is known thus far only from the Seychelles and the Glorioso Islands (about 120 miles off the northern point of Madagascar, in the Strait of Mozambique), where no other species of the genus has thus far been collected. Very likely it is to be found also in the Comoros, although typical *E. maxillosus* alone has been recorded there. It evidently does not occur on Madagascar, which possesses two color forms of *E. lepeleterii* (*pensilis* Saussure and *guerini* Saussure) and one of *E. maxillosus* (*reginus* Saussure), all peculiar to that island, in addition to typical *E. maxillosus*.

J. Pérez described *E. alluaudi* originally from Mahé. Cameron[1] recorded it as common on Praslin and Mahé. G. Meade Waldo,[2] who gives Silhouette and Dennis Island as additional localities, notes that it "very often makes its cells in rooms; it was not observed in the highest forests." Its habits are thus evidently similar to those of *E. maxillosus*. The same author comments as follows upon the reddish chrome color pattern of *E. alluaudi* being

[1] Trans. Linn. Soc. London, Zool., (2) 12, 1907, p. 71.

[2] Ibid., (2) 15, 1912, p. 43.

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repeated in *Odynerus seychellensis* Dalla Torre and *Crabro scotti* Turner: "It would seem that the insects with markings of this color are indigenous to the Seychelles, since none of the three species mentioned are found outside the group; on the other hand the widely spread and imported species preserve their normal type of marking."

EXCHANGE NOTICE.

WANTED:—Species of Tetraopes from all sections of the country, in exchange for Coleoptera of this region. Wm. J. Clench, Bussey Institution, Boston 30, Mass.

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NOTES ON CANADIAN AND ARCTIC SPIDERS.

By J. H. Emerton,
Boston, Mass.

Since the report on the spiders of the Canadian Arctic Expedition of 1913 to 1916, the writer has had opportunity to examine a considerable number of arctic spiders from the American Museum of Natural History of New York and from the Zoological Museum of Copenhagen, Denmark, the latter including some from Iceland. The Iceland spiders appear to be mainly species living in the British Islands and Northern Europe, while those from Greenland are for the most part Canadian, extending westward to Alaska and Siberia, and southward through the bogs of Canada to the mountain tops of New England and the Rocky Mountains of Canada and the western United States. The following notes give the results of comparisons of spiders from Greenland with those of the same or similar species living in Canada and the mountains of the northern United States.

Hilaira (*Erigone*) **glacialis**, Thorell, 1871, Spiders of Spitzbergen and Beeren Islands.

Erigone vexatrix (Camb. 1877), Koch 1879, Spiders of Siberia and Nova Zembla.

Hilaira glacialis Kulczynski 1908, Spiders of Russian Expedition to New Siberia Islands.

Spitzbergen, Siberia.

Collinson Point, Alaska, Canadian Arctic Expedition.

Saunders Island, West Greenland, Crocker Land Expedition.

Hilaira (*Erigone*) **læviceps**, Koch, 1879.

Hilaira læviceps, Kulczynski, 1908.

Tmeticus brunneus, Emerton, 1882, Connecticut Academy.

Siberia.

Nome, Alaska, Canadian Arctic Expedition.

Banff, Alberta, Canada. Sulphur Mt., N. B., Sanson.

Mt. Washington, N. H. Emerton, Slosson.

East Greenland, Angmagsalik, 66° north, Kruuse.

Lophocarenum (*Erigone*) **barbata**, Koch, 1879.

Diplocephalus barbatus, Kulczynski, 1908.

Siberia.

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Etah, West Greenland, Peary Relief Expedition, 1899.

Xysticus bimaculatus, Emerton, 1894. Canadian Spiders in Trans. Connecticut Acad.

Xysticus deichmanni, Sorensen, 1898. Vid. Med. Nat. For., Copenhagen.

Mt. Lincoln, Colorado, U. S., 10,000 ft. F. C. Bowditch, 1877.

Laggan, Alberta, Canada, 6,700 to 8,500 feet. Bean, 1890.

Eastern Greenland, 70° north. Deichmann, 1892.

Ashford, Washington, U. S. Emerton, 1905.

Arctic Canada, Bernard Harbor. Canadian Arctic Expedition, 1913 to 1916.

This species was found by F. C. Bowditch in 1877 on the upper part of Mt. Lincoln, Colorado, and it remained for a long time unidentified. In 1890 the females were found by Bean near Laggan in the Rocky Mountains of Canada, and described in 1894 by Emerton in a paper on Canadian spiders in the Transactions of the Connecticut Academy. About the same time it was found by Deichmann in Greenland and described in 1898 by Sorensen as *Xysticus deichmanni* in the Proceedings of the Natural History Society of Copenhagen, Denmark. The Canadian Arctic Expedition brought both sexes from the northern coast of Canada in 1916 and by comparison with these the specimens from Mt. Lincoln, Colorado, were at last identified.

Pardosa (*Lycosa*) **hyperborea**, Thorell, 1873, in Synonyms of European Spiders.

Pardosa luteola, Emerton, 1894. Canadian Spiders, Trans. Connecticut Acad.

Eastern Greenland, Th. Holm. Copenhagen Museum.

Southern Labrador, C. W. Townsend.

Quebec, Canada, Emerton.

White Mountains, N. H., in bogs at 4000 feet. Emerton.

James Bay, Canada, latitude 52½° north. F. Johansen.

Manitoba, Canada, west of Hudson Bay. Emerton.

Athabasca Landing, Canada, in bog. Emerton.

In bogs across Canada, from Greenland and Labrador to the Rocky Mountains and south to the mountains of New England and New York.

Pardosa furcifera, Thorell, 1873.

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This is described by Emerton in Canadian Spiders, Trans. Connecticut Acad., 1894, as one of the varieties of *P. glacialis.* It occurs in Greenland, Labrador, and Arctic Canada. It is usually larger than the typical *glacialis* and lighter in color, with much bright yellow on the legs, especially the under sides of femora and coxæ. In the paper referred to, Fig 2a, Plate IV, represents this species, and 2b its epigynum. The palpal organ differs little from *glacialis* and its relatives, but the male palpus is more slender and not much darker in color at the end than at the base, without the close black hairs which are characteristic of *glacialis* and *brunnea.*

Lycosa exasperans, Cambridge, Ann. Mag. Nat. Hist., London, 1877, from English Exploring Expedition of 1875-76.

This species has been identified by Strand in Fauna Arctica, 1906, with *L. alpigera* = *L. insignita,* Thorell. It is, however, distinguished from that species by the dorsal markings. The middle stripe of the cephalothorax in *exasperans* narrows in front between the eyes, widens behind the eyes, and narrows again in its posterior half. In *insignita* it widens regularly toward the front, so as to enclose the whole eye area. The abdomen of *exasperans* has usually a series of dark marks in the middle and a row of black and white spots at the sides. *L. insignita* has a large white middle mark surrounded by a black border and the spots on the sides are indistinct.

L. exasperans was found by the Crocker Land Expedition, 1917, at Saunders Island on the west coast of Greenland.

L. exasperans resembles closely *L. pictilis,* Emerton, which has similar markings, but is larger, more largely marked with orange hairs, and has a more angular epigynum. *L. pictilis* is found on the Mt. Washington range above trees up to the highest summits, on the coast of Labrador, and on the arctic coast of Canada. The Labrador specimens unfortunately are all immature.

L. mutabilis and *L. poecila,* described by Kulczynski, from Siberia, appear to resemble closely *exasperans* and *pictilis,* and it seems probable that comparison of a larger number of specimens would show that all these are one species extending along the arctic coast from Siberia to Greenland and south through Labrador to the White Mountains.

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Lycosa alpigena, Doleshall.
Lycosa insignita, Thorell, 1872.
Lycosa albohastata, Emerton, 1890.

Lycosa insignita, Thorell, supposed to be identical with *L. alpigena* of the Alps, is also the same as the American *L. albohastata,* Emerton. This species does not range as far north nor live at as high elevations as *L. exasperans* and *L. pictilis,* but it extends across America to the Rocky Mountains, being found several times at elevations of 5,000 to 6,000 feet at Banff. It occurs at low elevations on both sides of Hudson Bay, in Labrador, on the coast of Maine, and in the White Mountains just above the trees.

Drassus troglodytes, Koch, 1839.
Drassus troglodytes, L. Koch, 1866, Drassidæ.
Drassus robustus, Emerton, 1890, Trans. Connecticut Acad.
Southwest Greenland, Copenhagen Museum.
Iceland and Europe south to the Alps.
Massachusetts, New Hampshire, Mt. Mansfield, Vt.
Sandusky, Ohio, Chicago, Illinois.
Laggan, Alberta, Canada.
Vancouver Island, B. C., Canada.

PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB.

At the meeting, May 10, the committee on public lectures reported that four lectures had been given on Saturday afternoons in March and April in one of the small halls in Tremont Temple, on "Butterflies," by W. L. W. Field, on "Dragonflies," by R. H. Howe, Jr., on "Ants," by W. M. Wheeler, and on "Gall Insects" by A. C. Kinsey. An admission fee of 50 cents was charged, and there was an attendance of from one hundred to one hundred and fifty persons, so that enough was received to pay expenses of the course within ten dollars.

Mr. Reynolds reported the recent meeting of the New England Federation of Natural History Societies, in which three members of the Club took part.

Prof. C. T. Brues described a new minute Proctotrypid (Dol-

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chotrypes) parasitic on Cecidomyid larvæ which live in the sap vessels of freshly cut wood. The parasite has a long slender abdomen which varies in length in different individuals and is used in placing the eggs into the vessels of the wood.

Mr. Frost spoke of recent collecting of beetles and the different identifications of them by several experts whom he had consulted.

Mr. Walker spoke of finding a small insect larva in freshly exuded spruce gum. This led to a discussion of insects in gum and amber, which was joined in by Mr. Denton, Prof. Wheeler. and several other members.

At the meeting of June 14, Mr. L. W. Swett, who had lately been to the White Mountains, reported an unusually early season. At the Glen lilac and apple were in bloom, *Papilio turnus, Colias philodice, Pieris rapæ, Argynnis bellona* and *Thecla læta* were flying. The nights were warm, 55° to 60°, and collecting by light was tried on the Mt. Washington carriage road. Many species were taken, but in small numbers.

Mr. Dodge showed 140 species of Coleoptera, all taken on June 12, near Wilmington Junction.

The first meeting of the autumn was held on September 13, and Mr. C. W. Johnson gave an account of collecting at Mt. Desert, Maine, in June. The mountain maple, several species of Cornus, and raspberries were in bloom, and many insects were swept from the plants, among them many not before found on the island. Two thousand species of insects are at present known on Mt. Desert, more than half of them Diptera and Lepidoptera.

Mr. O. E. Plath showed several nests of bumble-bees which he had kept in boxes through the summer, and told about his observations on them, which will be published later in the year.

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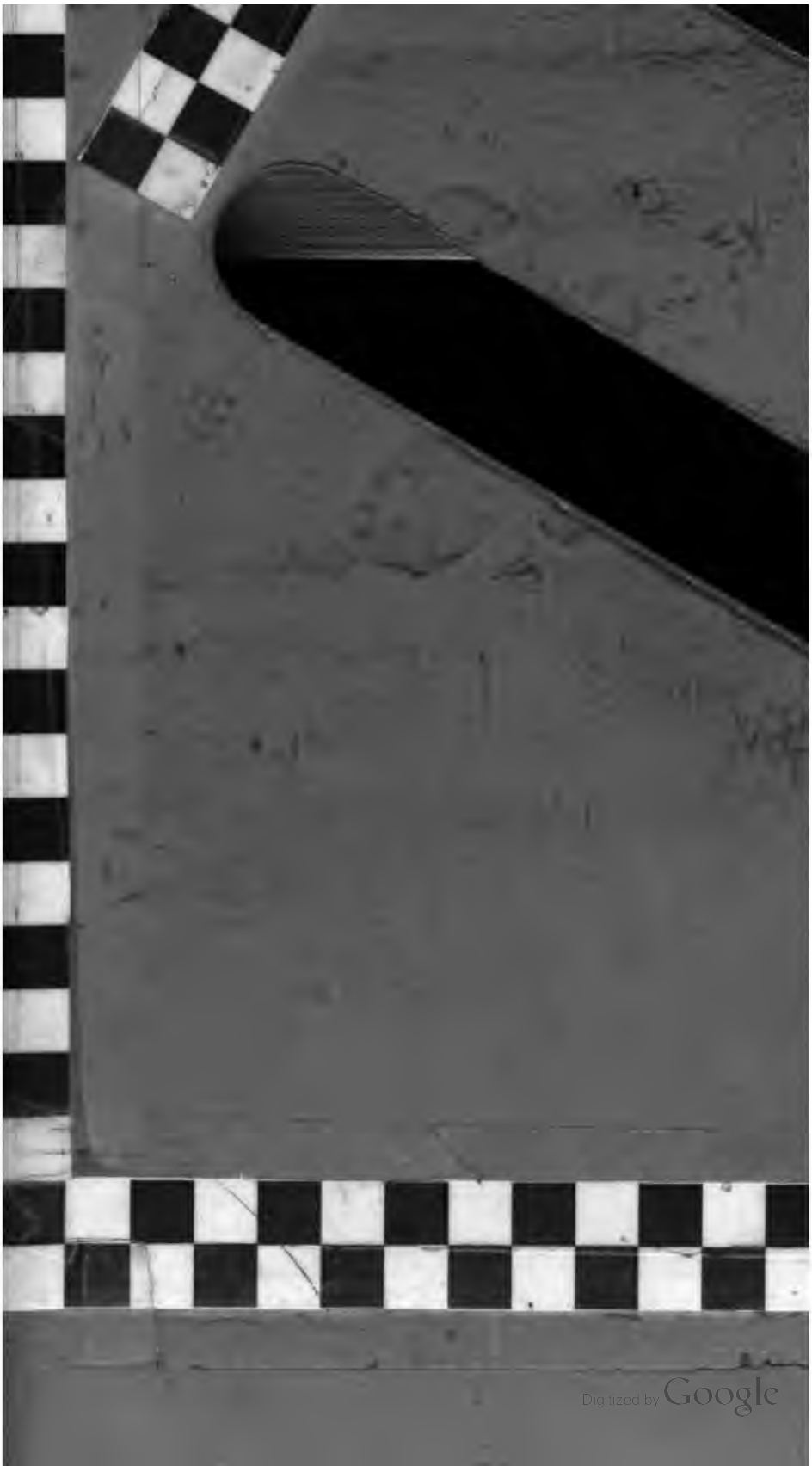
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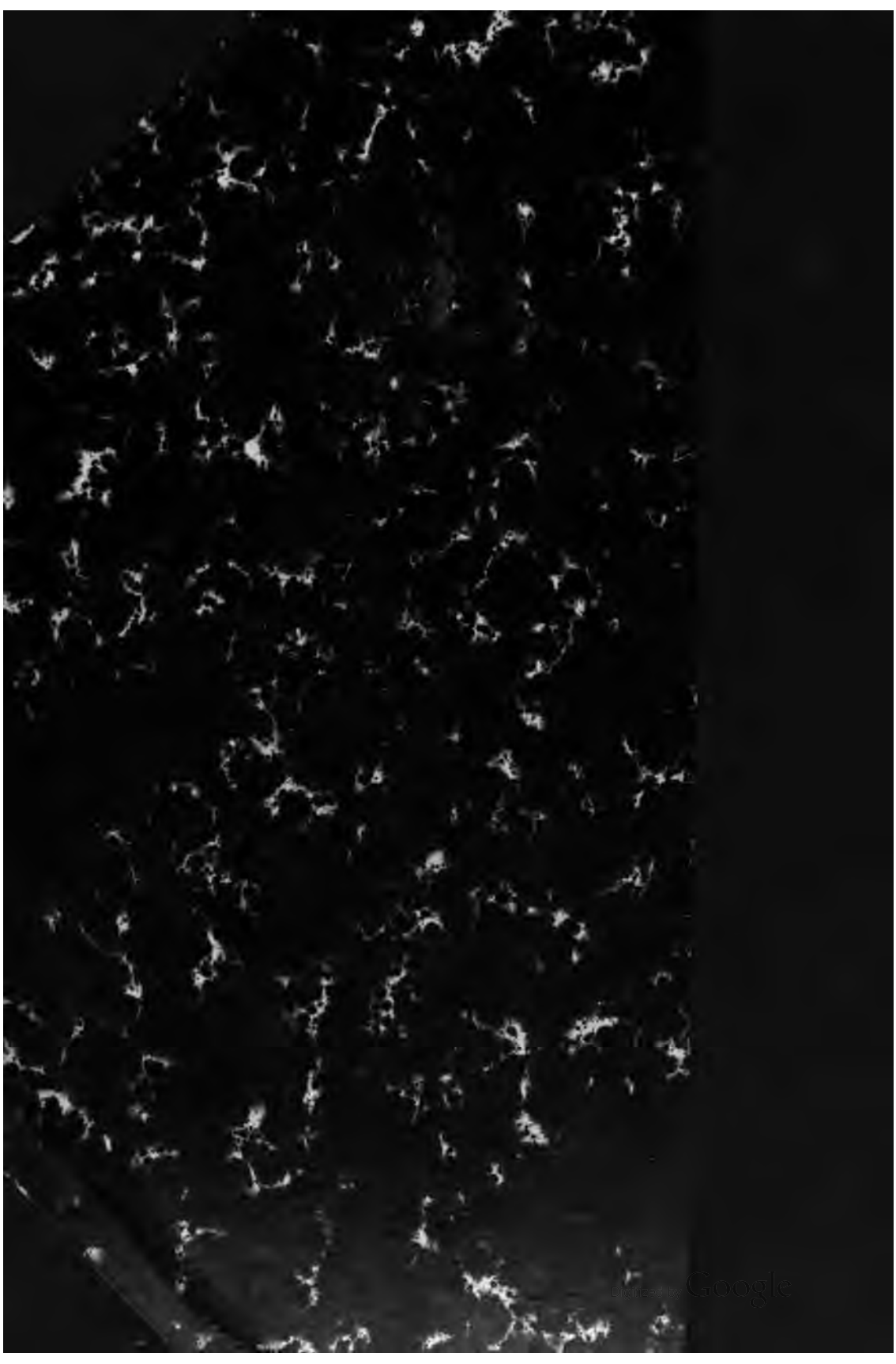

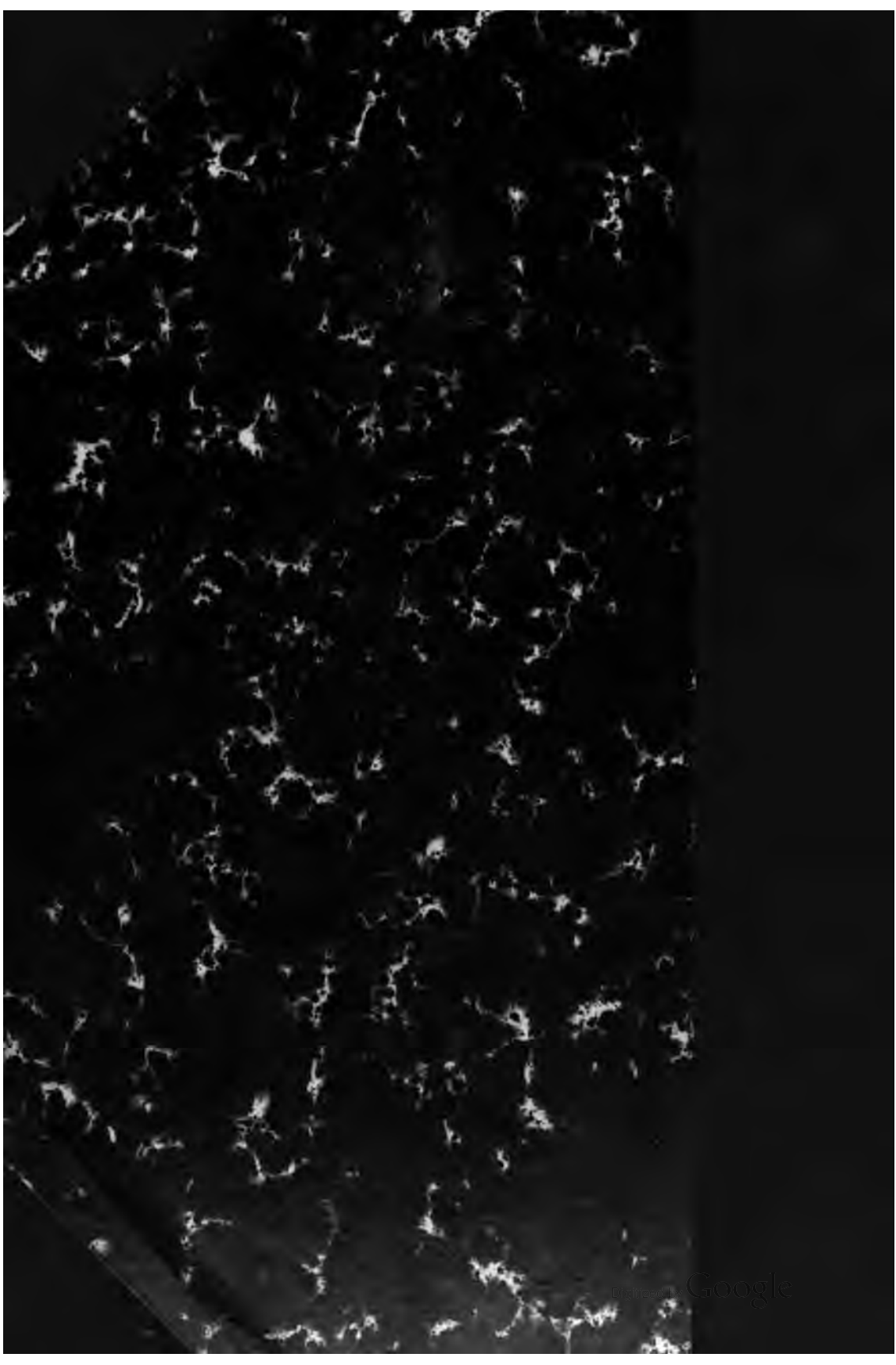
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